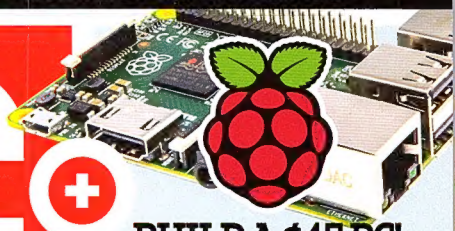
DIY WINDOWS 10 PC

DETAILED GUIDE: CREATE A BUDGET ALL-ROUNDER FOR MICROSOFT'S LATEST OS

apc

YOUR EXPERT

Sept 2015
Issue 419



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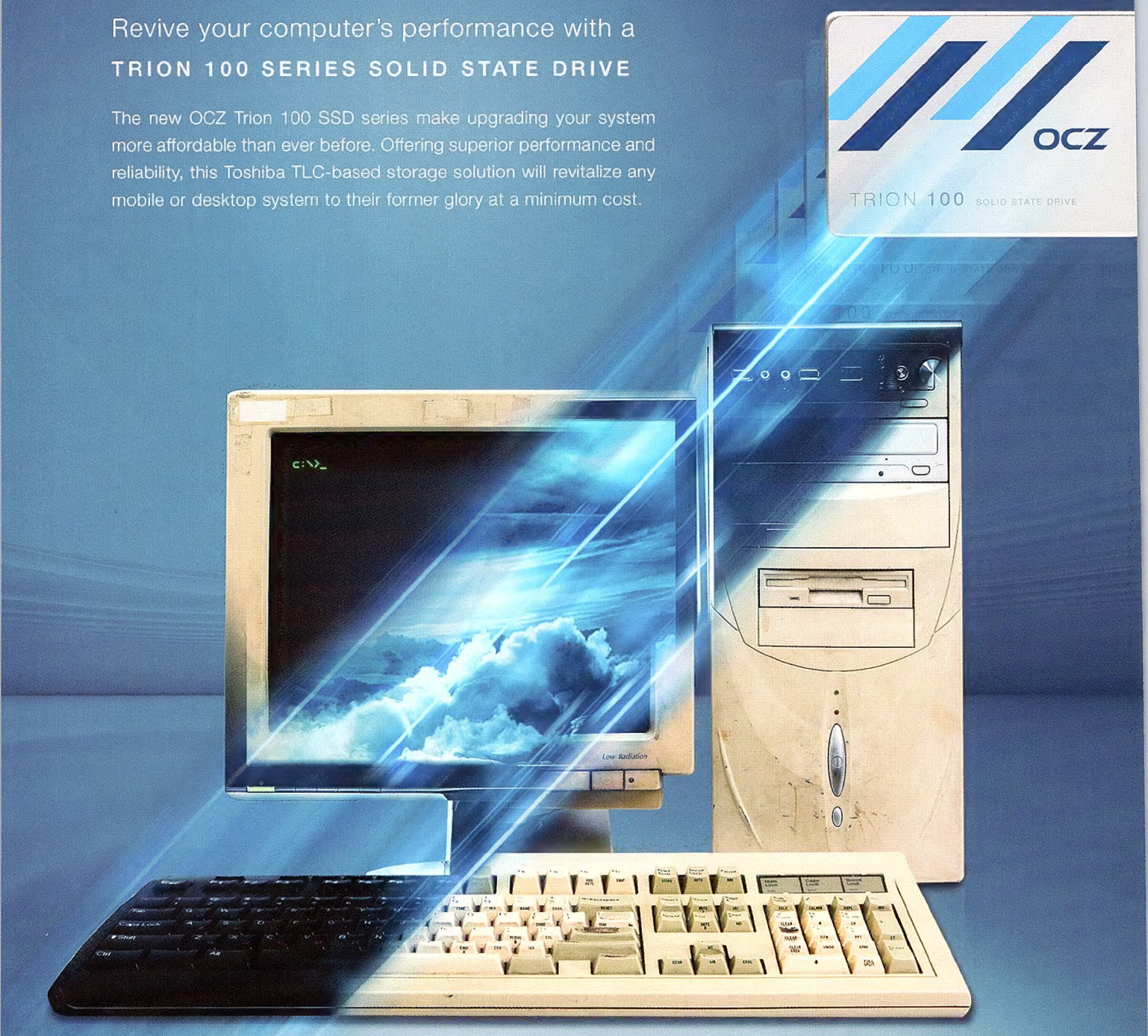

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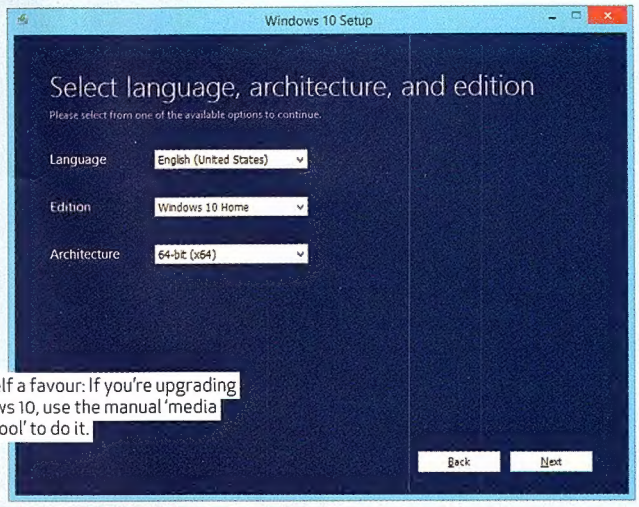

Do yourself a favour: If you're upgrading to Windows 10, use the manual 'media creation tool' to do it.

The Windows 10 upgrade experience

Living on the edge can still require a lot of troubleshooting know-how.

As we go to print with this issue of *APC*, Microsoft has just started rolling out the free Windows 10 upgrade. Judging just from the numbers – Microsoft claims 14 million devices were upgraded just on the first day – it'd seem to be off to a good start. Unfortunately, my own upgrade experience didn't quite go as smoothly as I'd hoped – although, admittedly, part of that could definitely be my own fault.

When upgrade day rolled around, I decided I'd leave my home PC (which runs an almost 2-year-old Windows 8.1 installation) switched on to see if the required 3GB of downloads would come down automatically via Windows Update – which apparently, they did... and then some, as I discovered when I got home. Windows 10's temporary upgrade folder housed not just 3GB of files, but a whopping 15GB! It seems that some of the downloaded files had been corrupted – apparently repeatedly – and Windows Update had been trying to replace them with good ones... and, failing time and again. (Thank goodness for unlimited broadband plans.)

Deducing that this problem probably wasn't going to resolve itself cleanly, I then went about deleting all the corrupted files and then trying to force Windows Update to start the process again... which, after a couple of hours of downloading more files, once again failed. The installer was still ending up corrupted.

"Screw Windows Update," was my general feeling at this point, so I went about looking for alternatives, finding that Microsoft's smartly put together a standalone tool for creating a Windows installer on a USB drive – the so-called 'media creation tool', which you can find here: **tinyurl.com/apc419-w10mct**. Using this to create a USB 3.0 flash drive with the Windows 10 installer, the upgrade process was fast – taking around 30 minutes – and completely flawless. (*APC*'s creative director, Troy Coleman, went through a similar 'corrupted downloads' experience, but also had a great experience with the media creation tool.)

And now that it's running, I'm pretty fond of the new OS. It's very quick, not just for Microsoft's own apps (like the excellent but a little under-featured Edge browser) but for using and launching third-party ones too. Not everything is working great, however. I run a dual-monitor setup, and trying to game on one screen and watch flicks on the other results in choppy video – and this is something that worked perfectly on Windows 8.1. Hopefully, these are just driver-related teething problems that will improve over the next few months – it still is very much early days for Windows 10.

If you've upgraded to Windows 10 already, what was your experience? And is there anything you particularly love or hate about it? ■

DAN GARDINER
EDITOR-IN-CHIEF
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Find your disc inside on page 83. (Australian edition only.)

GST threshold on imports could be reduced to $0

All online purchases set to receive a goods and services tax?

Recent comments by Treasurer Joe Hockey have suggested that the current GST-free threshold – which allows for purchases of up to $1,000 worth of imported goods without attracting the goods and services tax – could be scrapped entirely, which means that absolutely everything that is imported into Australia, regardless of the value of those goods, would have the GST applied to it.

Although it was recently stated that the threshold could be lowered to just $20, Australian retailers still say that's too high, and now Joe Hockey has suggested that the threshold could be dropped down to $0. It's been said that enforcing a lower GST threshold on imported goods would be expensive and difficult; however, a recent report claims to have found a way to reduce the cost drastically.

For comparison's sake, the tax-free threshold in the United Kingdom is set at £15 ($32). According to estimates by the NSW Treasury, the current $1,000 threshold will have cost Australia $3 billion in lost revenue by 2017.

Stephen Lambrechts

Intel's Skylake finally lifts off

Enthusiast CPUs and boards to land first.

For PC makers, Intel's new Skylake platform has been a long time coming. Consisting of sixth-generation Core i CPUs and accompanying 100-series chipsets, the hype has slowly been growing for the platform, with leaked benchmarks pointing to great base performance and fantastic overclockability.

The good news is that wait is finally over. Launching at the start of August are the enthusiast-oriented Core i5-6500K and Core i7-6700K CPUs and accompanying motherboards, based on the high-end Z170 chipset. Lower-end CPUs and boards are expected to start filtering through from September onwards.

The Skylake platform has seen multiple delays. At Computex in Taiwan in June, most major motherboard vendors were already showing off Z170 products, but CPUs were nowhere to be seen. Australian PC vendors have told *APC* that even leading right up to the launch, test CPUs were hard to come by, indicating that retail chips may initially be hard to find.

Skylake should also launch on laptops before the end of the year, with some multinational vendors anticipated to release products as soon as October. Taiwanese publication *Digitimes* is also reporting that Intel's NUC and Compute Stick product lines will see Skylake updates in Q4 2015.

We'll have a full report on the first sixth-generation Core i CPUs and Z170 motherboards next month.

New Aussie ISP automatically circumvents geoblocks

Is it time to ditch the VPN?

A new ISP that is currently scheduled for launch sometime before the end of August, is planning to dramatically change the way Australians can circumvent the geographical divides imposed on the web. Yournet (**yournet.global**) is boasting a technology called 'Global Mode' that will allow Australians to access foreign internet services, such as HBO Go or Netflix's US video streams, but won't block equivalent local services like ABC's iview — one of the current downsides to using a VPN.

According to a Fairfax interview with Yournet founder Raj Bhuva, the company has leased the Global Mode technology from Bypass Network Services, a New Zealand-based tech company that has landed some of its NZ ISP clients in legal hot water over the use of the technology. But in the interview, Bhuva stated that his company has legal advice suggesting geo-dodging is more clearly permitted under Australian law.

The company intends to launch with a $129.95 per month unlimited ADSL 2+ plan and is currently working on an NBN option. Yournet also intends to focus on offering better streaming quality by minimising the number of customers sharing network links.

Joel Burgess

Block unwanted Windows 10 updates

Mandatory updates? Microsoft's got a tool to deal with those...

After years of Windows users being able to pick and choose which security updates and new features would get installed, a controversial decision from Microsoft has made updates in Windows 10 mandatory, causing many early testers to get understandably peeved. Reports of an updated Nvidia driver causing performance issues on certain systems is just one example of how mandatory updates have so far bothered users.

Thankfully, there's also a way to avoid those unwanted updates – a troubleshooter package has been released that allows users to temporarily prevent a Windows or driver update from reinstalling in Windows 10. The package, which can be found by simply Googling 'KB3073930', was made for the Windows 10 Insider Preview, although it should also work on the final release version.

The troubleshooter will allow you to hide any updates that are causing you strife, and it will also let you manually select drivers for automatic installation. While this is a temporary solution, let's hope that a proper fix for this issue is on the way. **Stephen Lambrechts**

The final nail in the Windows Phone coffin?

Or can Windows 10 Mobile prevail?

Early in July, Microsoft announced that it would cut another 7,800 jobs from its Windows Phone division, adding to the already trimmed 18,000 Nokia employees following that company's acquisition early last year. In addition to the cuts, Microsoft CEO Satya Nadella stated that the company would write off its $7.6 billion Nokia acquisition as a whole, since the global market share of the Windows Phone OS has gone backwards in the past year to a new low of 3.2%. In light of this, Microsoft's stated it will focus on producing just a few tiers of Windows 10 Mobiles going forward. **JB**

Robot passes self-awareness test

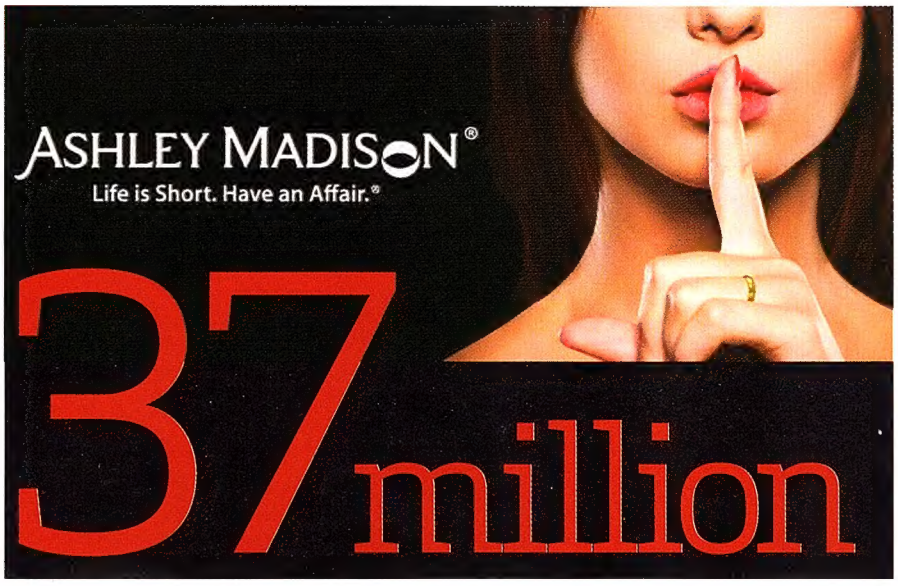
Me, myself and *I, Robot*.

In what's being called a milestone in AI development, an American-developed robot recently passed a rudimentary test in self-awareness. Selmer Bringsjord, a professor at Rensselaer Polytechnic Institute in New York sat three of his Nao humanoid robots in a room together and asked them a riddle intended to show self-awareness. Two of the robots had their vocal abilities turned off (though none of the three were informed) then the three were asked which robot was still able to speak. All three attempted to say, "I don't know," but only one succeeded. The successful robot then recognised its own voice and deduced that it was the robot not silenced by saying, "Sorry, I now know." **JB**

Razer buys Ouya

A new player in lounge room gaming?

In June, financial advisers to laptop and gaming hardware manufacturer Razer unintentionally revealed that the company was in talks to acquire indie Android console maker Ouya, which launched following a successful Kickstarter campaign in 2012. After more than a month of speculation, Razer has finally stepped forward to officially announce the acquisition. Ouya has been an interesting independent player in the console market, but has struggled to gain any real market traction following its launch in 2013. TechCrunch reported that Ouya had been valued between US$60-80 million in the lead up to the deal, although how much Razer paid for the company has not officially been disclosed. **JB**



THE NUMBER OF USERS OF ADULTERY WEBSITE ASHLEY MADISON THAT COULD BE SPRUNG.

The controversial online matchmaking website Ashley Madison — which flaunts the tagline 'Life is short. Have an Affair' — was breached in mid-July by a hacking group known as The Impact Team. According to Krebs on Security, Impact Team claims to have accessed everything from user databases to financial records and is threatening to release the information online if the service isn't taken down permanently. So far, only a small portion of the user data has been published, but Impact Team has threatened to release more for every day the site remains online.

92%

APPLE'S SHARE OF GLOBAL SMARTPHONE PROFITS.

There are roughly 1,000 smartphone manufacturers around the world and although Apple's iPhones only account for about 20% of total device sales, the company's estimated to have made 92% of the profits in Q1 2015. That's based on an analysis of the leading eight smartphone manufacturers, according to research firm Canaccord Genuity. In the same analysis, Samsung came in second, but was estimated to have only raked in around 15% of the profits… and that's a figure which only makes sense because both HTC and Microsoft recorded operating losses on smartphones.

10 years

THE LIFE CYCLE OF WINDOWS 10.

Traditionally, Microsoft has developed new Windows OSes every three or so years, and offered five years of support via updates, with the option to purchase 'extended support' to take that to 10 years. With Windows 10, however, Microsoft has been eager to reiterate that it'll continuously push out big updates to the OS (rather than holding them back for the next big Windows release) and that this will in fact be the 'last version of Windows'. Yet an update to the Microsoft website recently stated that Windows 10 will receive updates and support for the same five- and 10-year periods. Which begs the question: if there's no Windows 11, what happens once support ends for Windows 10?

40 minutes

THE AVERAGE LENGTH OF A YOUTUBE VIEWING SESSION.

In Google's Q2 2015 earnings report announced in June, the company's new CFO Ruth Porat made special mention of how well YouTube was performing. Up 60% from last year, the average viewing time for YouTube users is now 40 minutes, with mobile viewing also up over 50%. It was also mentioned that it attracts more 18-49-year-old viewers than any cable company in the US and that a number of YouTube channels have earned six-figure revenues in the past year.

1/2

THE PROPORTION OF SPAM IN YOUR EMAIL INBOX.

According to recent figures from cyber-security firm Symantec, less than half the emails you receive today are junk mail. The company found that only 49.7% of emails received were spam — a figure that hasn't been that low since 2003. In June 2009, 5.7 trillion spam emails were sent, accounting for about 90% of the total number of emails exchanged, but by June this year only 353 billion emails out of a total of 704 billion emails were spam. Symantec didn't speculate on the cause of this drop, but such declines in spam are generally attributable to improved filtering and reaction times from network providers and an increase in the legal prosecution of companies running botnets.

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technotes

» GEAR WE WANT

NINEBOT ONE E+

US$950 | NINEBOT.COM

With its sleek black-and-white styling, this looks like it could be from the set of *Oblivion* or *I, Robot* or *Moon* or the end of *WALL-E* or... wow, a lot of films look the same. Where were we? Right! The One E+ is a single-wheel self-balancing scooter for carving your way through the city on your commute at a breezy 18-22km per hour, travelling about 30-35km on a single charge. It's what the Segway could have been if it hadn't ended up as the international symbol of the socks-and-sandals crowd.

COMMODORE PET

FROM €289.00 | WWW.COMMODORESMART.COM

Get ready to feel super old and nostalgic: the Commodore brand is back – as an Android-powered smartphone. The Commodore PET (named after the 1977 computer) sports a 5.5-inch screen, a 1.7GHz octa-core Mediatek processor, a 13MP rear-facing camera and a 3,000mAh battery. Two custom emulators will also allow users to revisit their favourite Commodore 64 and Amiga games. Italy, France, Poland and Germany will get it first, though expect an Australian release soon enough. It'll cost around $430 for the 16GB model and $525 for the 32GB model (a 32GB microSD card is included with both).
Stephen Lambrechts

SPHERO DARKSIDE OLLIE

$199.95 | SPHERO.COM

Earlier in the year, robotics toy maker Sphero made headlines on the web for helping create the tech powering droid BB-8 in the upcoming *Star Wars: The Force Awakens*. Soon after the announcement, the app-connected toy company introduced Darkside – an edgier version of its smartphone-controlled cylinder bot named Ollie that was released late last year. The main difference between Ollie and Darkside – apart from their differing Jedi colouring – is that Darkside comes with an additional set of stiff plastic tyres, which'll allow this shady little gadget to drift across your kitchen tiles. **Joel Burgess**

BOOSTED BOARDS

FROM US$999 | BOOSTEDBOARDS.COM

With their bigger wheels and broader surface area, longboards have always been a great option for skaters who wants something a little more practical than a double-kick trick board to get around on. But a few years ago, a Kickstarter called Boosted Boards added a feature to the traditional longboard that made them even better for transport: an electric motor. As long as you had deep enough pockets to fork out US$2,000 for one, you'd never have to wear out your sneakers pushing or breaking again. But this year, BB's released an upgraded model that not only performs better, but also costs half as much as its predecessor. We want one. **Joel Burgess**

TRACKIMO

$199.95 | TRACKIMO.COM.AU

Tile-tracking devices for your keyring are an interesting low-cost option for locating lost items within the house, but because they use Bluetooth, they'll only show up on your phone if you're within range. Though Trackimo is a little more expensive than your average tracking tile, it's also a lot more powerful. With a built-in international SIM card, Trackimo uses cellular technology to locate the device and you can see exactly where it is at any time by setting up an online account and downloading the Android and iOS app. If you need genuine GPS tracking device, this one's versatility could be worth the higher price. **Joel Burgess**

STAR TREK BLUETOOTH COMMUNICATOR

US$149.95 | SHOP.STARTREK.COM

Every *Star Trek* fan has wanted a working Starfleet communicator at one point or another, and now it actually exists! The Star Trek Bluetooth Communicator is an officially licensed and incredibly accurate replica, designed using structured-light 3D scans taken of the Alpha Hero Prop that appeared in the show. When connected to your smartphone, it will allow you to make and receive calls, and even use it as a wireless speaker. It will also include sound effects and conversation segments from the original television show, allowing you to pretend-chat with Scotty and Co. when it officially launches in January 2016 at an estimated price of $200. **Stephen Lambrechts**

Galaxy S6 Edge

It looks great, is powerful, and has a good camera, but in some ways, the S6 Edge has gone backward.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit **www.ifixit.com**.

BACKGROUND

With its glass and aluminum construction and curved-edge screen, Samsung looks to have leaped light-years ahead with its newest flagship smartphone, the Galaxy S6 Edge. But is it as future-proof as it is futuristic? Only a teardown will tell...

MAJOR TECH SPECS

- 5.1-inch Super AMOLED capacitive touchscreen (1,440 x 2,560, 16 million colours)
- Samsung Exynos 7 Octa 7420 processor, integrated ARM Mali-T760 GPU and 3GB memory
- 16MP rear camera with HDR, LED flash, and 4K video recording
- Built-in support for Qi and Powermat wireless charging
- 32/64/128GB storage options, but no microSD slot

KEY FINDINGS

- The rear panel is glued on rock-solid. We had to break out a suction cup to slip in an opening pick. Definitely not fun. With the panel finally off, the adhesive peels off the glass nicely, but leaves a sticky residue on the metal midframe.
- Using a screwdriver and plastic opening tool, the midframe comes off easily, revealing all the goodies. However, the battery is still held captive under the motherboard. We'd normally remove the microSD card now, but Samsung eliminated it. If you need extra storage, you'll need to pay for it up-front.
- We pluck out the main camera to get a better look at the hardware. The 16MP OIS rear-facing camera dwarfs the 5MP selfie cam. On the front we find: Samsung Exynos 7420 octa-core processor (64-bit), 2.1GHz Quad and 1.5GHz Quad, along with Samsung K3RG3G30MM-DGCH 3GB LPDDR4 RAM and Samsung KLUBG4G1BD 32GB NAND flash.
- A glass back and a stubbornly glued battery? Samsung, have you been hanging out with Apple? Finally free, we get a better look at the 3.85V, 10.01Wh battery. It's a 2,600mAh battery, like the S4.
- In what seems another step backward, the S6 dumps the S5's lightning-fast Micro-B USB 3.0 port for a microUSB (2.0) port. Apart from saving some space, we fail to see the point of this.
- The Super AMOLED display is what allows for the smooth curves. Riding on the back of the display is the customary touchscreen controller, this time an STMicro FT6BH.
- Repairability score: 3 out of 10 (10 is easiest to repair). Many components are modular. In an improvement over the S5, you no longer have to remove the display to get into the phone and replace the motherboard. Front and back glass makes for double the crackability, and strong adhesive makes it hard to gain entry. The battery is very tightly adhered, and buried beneath the midframe and motherboard. Replacing the glass without destroying the display is going to be very difficult. ■

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If you need backwards compatibility with 16-bit application and games, you'll have to install the 32-bit edition of Windows 10.

"If you install the 64-bit version of Windows 10 then (as on Windows 7 and 8.1) you lose native 16-bit capabilities — the only way you'll be able to run older apps is via some form of emulation or in a dedicated virtual machine."

WINDOWS 10 AND LEGACY APPS

One thing that has not been talked about in *APC* is the state of play regarding 16-bit legacy programs (games and so on). Will they run under Windows 10?

Robert McLardy

Ed replies: ***That depends which edition of the OS you have. Windows 10 doesn't actually alter the situation with regards to backwards compatibility and 16-bit apps at all — as on Windows 7 and 8, the 32-bit version of Windows 10 will still let you natively run 16-bit applications. However, if you install the 64-bit version of Windows 10 then (as on Windows 7 and 8.1) you lose native 16-bit capabilities — the only way you'll be able to run older apps is via some form of emulation or in a dedicated virtual machine.***

POWERLINE AND SWITCHES

I have been re-reading the April mag regarding networking with powerline adaptors, which I am going to do. Page 43 has a photo of a D-Link AV2 2000 and above it is a multiple plug or switch or something I can't see any description of. Is it to allow several items to be hooked to the adapter. Where can I get it and what is it called please? The description just says neater than cables across the floor. Yeah! I want one!

Lyndon Hutchinson

Ed replies: ***The picture on page 43 is actually of a simple Ethernet wall plate, as described in the second paragraph of the main story. Installing one will require running Ethernet cables in your wall and/or floor cavities — the results are nice and neat, but setup is obviously quite a bit more involved than with powerline's plug-and-play approach. If you need multiple ports, you can still use power line: there are some older products (released around 2011) that offer a multi-port Ethernet switch at one end and a single-port powerline plug at the other from the likes of D-Link and NetComm. Alternatively, you should be able to just plug a standalone network switch directly into the output of a single-port powerline plug...***

WINDOWS 10 SLOW PERFORMANCE

I have read all your articles on the Windows 10 technical preview with great interest. However, the one area which seems not to be well covered is its performance. I have tried it on two machines.

The first is a gaming machine running an Intel Core i7-2600K with an Nvidia GeForce GTX 970 graphics card. I first loaded an early release of the preview and did not like its look and feel, so I restored Windows 8.1. It seemed to perform reasonably but I didn't have it loaded long enough to really put it through its paces.

Recently I downloaded the latest version available. Look and feel were greatly improved, but my computer ground to a halt. *Star Wars: The Old Republic* could not be played at all, and that doesn't require a huge amount of resources.

I also have it on an Intel dual-core laptop with a clock speed of 2.4GHz. In order to get a reasonable level of performance I had to end several Microsoft processes and only then was it was usable.

I believe the public must be alerted to a serious performance hit with Windows 10, as many are likely to be enticed to jump in due to it being a free upgrade. I believe the major hit to the gaming machine is a bug, as the first load of Windows 10 was not so slow. Perhaps it is a result of rolling back and then reloading Windows 10, in which case it is a defect in the software. Personally I will keep trying it, but unless I see a major improvement, I will remain on Windows 8.1.

Jeffrey Travers

Ed replies: ***Those definitely sound like problems that could be caused by the preview build being non-final and many drivers (including GPU drivers) not yet being optimised for Windows 10. We've not had significant performance issues with Microsoft's new OS in our testing, but we're investigating its gaming speed (in particular) for an upcoming feature. Stay tuned...*** ■

APCMAG@FUTURENET.COM

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Gettysburg was one of the many legitimate historical games pulled from the App Store by an overreacting Apple.

Brands behaving badly

This month, Stephen Lambrechts investigates some baffling business decisions made by big tech companies...

When a company has been around for a long time, it earns a certain amount of trust from its customers. With that said, goodwill can turn to bad blood in the blink of an eye when a decision is made that negatively impacts consumers. While it's comforting to imagine that only younger companies make mistakes, not even the likes of Apple, Samsung and Warner Bros. are impervious to making bad decisions on occasion, despite having been in business for a combined 208 years.

Apple's recent faux pas involved a knee-jerk reaction to a racially-motivated mass shooting in Charleston, South Carolina, which saw the Cupertino company take down all apps featuring images of the Confederate flag from its App Store. While the gesture came from an area of sensitivity in reaction to a devastating occurrence, fuelled in part by a movement which saw several state governments and businesses remove the flag from public areas, it failed to take into account the many historical apps on the service that feature the flag for educational purposes and for the sake of accuracy. Several developers of historical games and educational apps received messages from Apple after their apps had been removed, stating that they were taken down for displaying "the Confederate flag in offensive or mean-spirited ways". Apple has since reversed many of the bans.

Meanwhile, Samsung recently made the 'security motivated' decision to disable Windows Update on its laptops, forcing its customers to use its own SW Updater tool. A program called 'Disable_Windowsupdate.exe' was found by a researcher while debugging SW Updater, which, as the wording would suggest, blocks access to Windows Update within the Windows registry. Some have suggested that the tactic was a precautionary move by Samsung to prevent Microsoft's updates from removing its pre-installed bloatware. While Samsung initially denied SW Updater was blocking Windows Update, stating that "it is not true that we are blocking a Windows 8.1 operating system update on our computers", it eventually switched gears, telling Gizmodo that the company would be "issuing a patch through the Samsung Software Update notification process to revert back to the recommended automatic Windows Update settings within a few days."

In Warner Bros. Interactive Entertainment's case, the bad decision was to issue PC gamers with a broken port of its biggest game of the year, *Batman: Arkham Asylum*. Calling its launch on PC an absolute disaster would be an understatement, as the port suffered from crippling performance issues that saw even the beefiest PCs running the game outperformed by consoles. The port, which was outsourced to *Killer Instinct: Season 2* developer Iron Galaxy, saw Batman face his most diabolical adversaries yet – a locked-down frame rate of 30fps, stuttering, and the lack of high-performance visual effects, such as bokeh depth-of-field, ambient occlusion and transparency layers for rain and wet surfaces. The problems with the game are so severe that Warner Bros. has indefinitely suspended sales of the title on PC until original developer Rocksteady can iron out the numerous bugs.

While these are just a few examples of how bad decisions can hurt a brand's reputation, they show clearly that everyone is vulnerable in the age of social media and constantly updated internet news. That means now, more than ever, companies need to think twice before giving consumers the short end of the stick.

ENDUSER

Share your stories!

If you have an iteresting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Making motherboards

Ever wondered what goes into assembling a PC motherboard? Shaun Prescott reports after receiving a first-hand look in Taipei earlier this year.

Down on the fifth floor dozens of production line workers apply the more fiddly components of a motherboard

As part of a guided tour to coincide with Computex in June, Gigabyte took me to its Taipei motherboard factory on the outskirts of the city. Situated in a small industrial town about an hour out of central Taipei, Nanping is the biggest of the company's three motherboard plants, with the other two – Dongguan and Ningbo – based in China. Opened in 2000, Nan Ping employs 1,500 people and produces 575,000 motherboards per month. Each of these are tested before shipping, and each are created with a mixture of automation and manual labour.

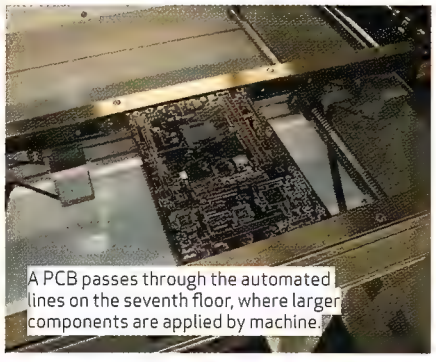
The only aspect of motherboard creation not accounted for at Nanping is the printed circuit board (PCB), which is made in China. Otherwise, each motherboard is crafted 'from 0 to 100%' at the plant. On the seventh floor, large (and loud) surface-mount technology (SMT) machines slot tiny resistors and other chips onto the PCBs, with several workers responsible for testing the results at the end of the line. These SMT machines are capable of slotting in components at a speed of half a second, with long reams of tiny components fed into the SMT automatically.

While the seventh floor is mostly automated, the manual assembly line two floors down is where the more delicate work happens. That said, it doesn't look delicate – dozens of Taiwanese women sit elbow to elbow placing components at blinding speeds – but a lot of care and attention is afforded to the process and again, every motherboard is also function-tested before leaving the premises. Each worker wears an antistatic wristband, and each has trays full of ports, chips and transistors, which they apply as a conveyor transports an endless stream of PCBs throughout the floor. On the day I visited, the target was 1,500 motherboards. That's a lot of USB ports manually slotted in.

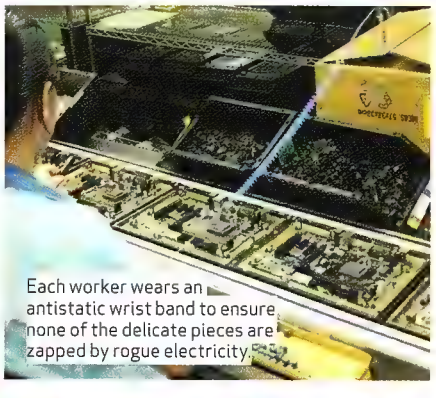
Down on the second floor is where packing happens. This is a thorough process and, despite being the least technical part, easily the most fascinating: machines beat cardboard boxes into shape while men and women carefully place the motherboard, cables, driver disc and all manuals into the package you purchase at retail. While the process of building the actual motherboard may seem remote and foreign to anyone with sub-professional technical knowledge, watching the actual product materialise before your eyes is... well, eye-opening. The next time you throw your motherboard's manual away, keep in mind the guy tasked with putting 1,500 of these into 1,500 boxes, every day. Each motherboard package is then stacked into a bigger box and sent directly from Nanping to Gigabyte's wholesalers.

That's a lot of motherboards built per day, and for what is arguably the least sexy component of a PC, quite a lot of work. For me, the tour was a welcome reminder that PC components don't just materialise from out of nowhere in boardrooms or retail outlets: they're painstakingly constructed by dozens of human hands.

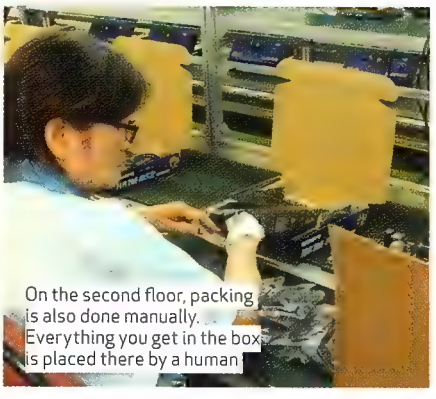
Shaun Prescott attended this year's Computex courtesy of Gigabyte.



A PCB passes through the automated lines on the seventh floor, where larger components are applied by machine.



Each worker wears an antistatic wrist band to ensure none of the delicate pieces are zapped by rogue electricity.



On the second floor, packing is also done manually. Everything you get in the box is placed there by a human.

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Gearing up for boundary breaking performance? Go no further and check out the stunning ROG Maximus VIII Extreme! Looking for a value-packed gaming focused motherboard that won't break the budget? The ASUS Z170-Pro Gaming motherboard has your back. Whether you want a full-sized ATX motherboard like the ROG Maximus VIII Hero or a small form factor ready Mini-ITX motherboard like the Z170i-Pro Gaming, the ASUS gaming range has a solution to meet your needs.

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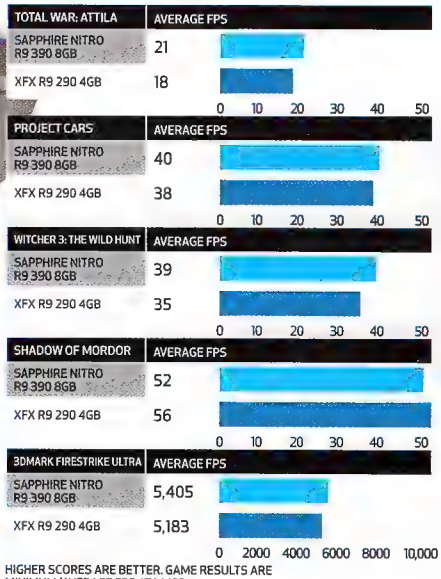
Gaming performance



HIGHER SCORES ARE BETTER. GAME RESULTS ARE MINIMUM/AVERAGE FPS AT 1440P.

Sapphire Nitro R9 390

1440p gaming? No problem!

So let's get right to it. Is the R9 390 a rehashed core? Yes, kind of. It's the same Hawaii core found in the R9 290 nearly two years ago. It has the same number of streaming cores at 2,560, the same GDDR5 memory and the same number of transistors littering the GCN GPU. Understandably then, you're probably wondering why you should bother purchasing one of these cards. Good question.

For a card that uses more power with just a slight overclock over the reference card, it certainly doesn't make much sense to upgrade if you already have an R9 290. Unless, of course, you're after that 8GB memory figure, in which case it might be worth your time. Laughably though, there are people out there who have managed to flash their R9 290s to 390s, using the latest R9 300 series BIOS, most likely to AMD's disapproving frowns.

So, who should be looking at this card then? Well, if you're still on a Tahiti core, or a 600 series card from Nvidia, this is definitely a suitable solution to your graphical woes. It's fantastic for gaming at 1440p, and thanks to Sapphire's Nitro implementation (because apparently nitrous oxide cards are a thing), this card overclocks above and beyond anything we really expected.

In our testing, we found that with games such as *Witcher 3*, *Shadow of Mordor* and *Project Cars*, our R9 390 was regularly only around 10-15fps behind AMD's flagship Fury X, purely thanks to the Nitro's ability to aggressively overclock, no doubt. That may still seem like a big disparity between the two, but there's something you might want to take into consideration – the Nitro is currently half the price of the Fury X. How interesting are those figures sounding now?

So, the obvious solution here would be to run two of these bad boys in CrossFire – the same performance as a single Fury X with twice as much memory, for the same cost. Say what you like about HBM (high-bandwidth memory) – yes, it's revolutionary – but it's just not there yet. And with DirectX 12 merging dedicated graphics card memory together, you'd be looking at a setup containing four times the memory of a single Fury X card for the same price – 16GB to be exact. An insane solution, to say the least.

Sapphire's Nitro Tri-X fan design is a fantastic cooling solution, providing dissipation for that massive heatsink with one 10mm heatpipe, two 8mm heatpipes and two 6mm heatpipes. It's well cared for. The card also has a (rather terrifying in our opinion) 0db fan feature, so if you're not gaming, those fans aren't spinning – ideal if you're often working from home. Even so, it's not exactly a noisy cooler when it does spin up. Even in Furmark's GPU stress tests we only hit 69°C, with the fans spinning at around 65% capacity.

What would've been nice to see on the Nitro is a backplate, but then Sapphire presumably reserves those specifically for its 390X iteration and beyond. Understandable, but it would have helped to transform this GPU into the lustrous black beauty it so righteously deserves to be. Otherwise, we have no bones to pick with Sapphire's offering. Yes, it's a rebrand, but it still performs admirably. When it comes to bang-for-your-buck performance, it's on a par with AMD's Fury X, if not better.

■ Zak Storey

Verdict

Features ★★★★
Performance ★★★★
Value ★★★★

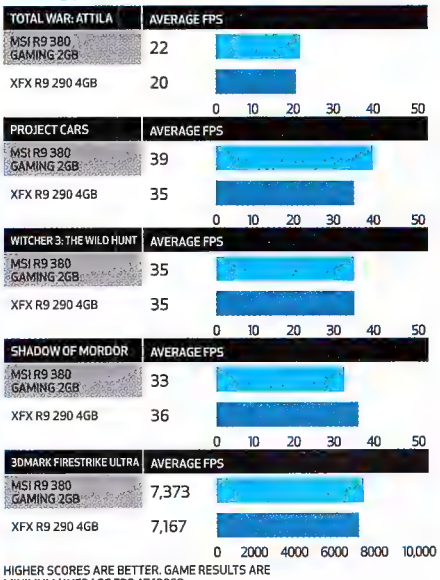
Great value; fantastic cooling solution; very clean; more memory; CrossFire potential.

★★★★☆

$499 | AU.MSI.COM

LABS BENCHMARK RESULTS

Gaming performance



HIGHER SCORES ARE BETTER. GAME RESULTS ARE MINIMUM/AVERAGE FPS AT 1080P.

MSI R9 380 Gaming

Premium looks, value results.

On a tight budget? Looking for a graphics solution under $500? Want to play the latest games comfortably at 1080p? Well, the R9 380 might just be the card for you. OK, we'll drop the advertising pitch. But seriously, if you're looking for a budget buy to build your 1080p gaming/LAN rig, the 380 is a serious competitor.

Small and light, the R9 380 series brings to the table that faithful Tonga core – an architecture that's been providing AMD with budget-crunching frames since 2011. Here, of course, we're referring to the Tahiti core found in AMD's 7000 series graphics cards from yesteryear, being reworked into the Tonga architecture late at the end of the R9 200's life cycle. Either way, it's a powerful core. Featuring 1,792 shaders and 2GB of GDDR5 (or 4GB, depending on which option you go for) on a 256-bit bus, this card is designed from the ground up for gaming at 1080p.

That's all well and good, but should you buy it? It's certainly appetising for those on a tight budget – indeed, it's our graphics card of choice in this month's 'Build a budget Windows 10 PC' feature on page 70. The performance is less than desirable if you're looking to game at 1440p or 4K, but it copes very well at the lower-end resolutions, achieving benchmarks in line with that of the GTX 960, showing that even an aging core can keep up with the best of the new breed.

The one major problem the R9 380 has over its Nvidia rival is power draw. Requiring an additional six-pin connector, the 380 also pumps out a whopping 65W more heat, making those fans spin that extra bit faster.

That being said, MSI's R9 380 Gaming is a stunning card. The build quality is phenomenal for a GPU at this price point.

Featuring MSI's Twin Frozr cooler, now in its fifth iteration, the card rests snugly at around 72°C, even when overclocked. The fans rarely spin up above 70%, and when they do, it's not noticeable in comparison to the reference cooler.

Another feature becoming increasingly commonplace in the market nowadays is the addition of 0dB fan speeds. It's fantastic if you're just browsing the web or playing *Minesweeper*, but it does take a little while to get used to the fans not spinning when powering on. Once your monitor's booted and you've stopped panicking over whether your card's dead, however, we're sure you'll appreciate this new piece of software.

What's more impressive is how MSI has managed to pack such a solid card into such a low price. The cooler is the same design that you'll find on MSI's 390 and 390X, featuring the same backplate and LED lighting features. Put simply, it... looks... stunning. There's no way around it, and regardless of whether that backplate helps cool the card down or not, it suits the card perfectly and looks clean in a tidy build.

But back to the all-important question: is this the graphics card for you? That depends entirely on what you want to do with your rig. If you're content with gaming at 1080p, then the R9 380 is undoubtedly a strong contender. However, if you're wanting to go further and push that resolution-based barrier beyond the confines of the traditional, you might want to look to the R9 390 or the Fury X. At those levels, this card simply won't cut it.

Zak Storey

Verdict

Features	★★★½
Performance	★★★★
Value	★★★★

Fantastic cooler; whisper quiet; strong 1080p performance; clean looks; good price.

★★★★½

A real pocket rocket

THE SAMSUNG PORTABLE SSD T1 IS THE ULTIMATE IN PORTABLE STORAGE.

Designed for creative professionals and demanding business users on the go — or anyone who just wants a slick and speedy storage device — the Samsung Portable SSD T1 houses up to 1TB of Samsung's class-leading solid-state NAND flash memory in a very compact package. And with USB 3.0, there's no bottlenecking when you're copying data to and from your PC. It's the no-compromise storage device that combines amazing features with a sleek and stylish package.

FAST

The Samsung Portable SSD T1 is built from the ground up for speed. Taking advantage of Samsung's extensive SSD know-how, the T1 range offers read and write speeds of up to 450MB/s* — that's up to six times as fast as a regular mechanical hard drive. That means it's fast enough to tackle almost any storage-intensive task you can throw at it. Whether you're editing 4K video or just looking for the quickest loading times in games, the T1 won't leave you waiting.

SAFE

When it comes to data security, the Samsung Portable SSD T1 also has your back.
With virtually uncrackable hardware-based 256-bit AES encryption onboard, you can protect your data from prying eyes. And when you want to access your private files, it's just a matter of entering your password. It's not just encryption that protects your data either. With solid-state technology, the T1 doesn't have any vulnerable moving parts, meaning it's much better-equipped to stand up to the rough-and-tumble that portable drives inevitably experience.

STYLISH

Samsung hasn't compromised in the style department either. With a classy and sleek black polycarbonate chassis, the T1 packs all that storage and speed into a package that has a footprint that's around two-thirds the size of your average business card. Images don't do justice to how compact the T1 really is: you need to see it in person. This is an elegantly-designed drive with a thin profile and, weighing in at a tiny 30g, it can easily slip into a shirt or pants pocket without being a burden.

In short, the Samsung Portable SSD T1 delivers a mass of speedy storage that comfortably fits in the palm of your hand, all based on Samsung's trusted SSD expertise. With the T1, Samsung hasn't compromised — so you don't have to either.

SPECIFICATIONS

CAPACITIES
250GB, 500GB, 1TB

INTERFACE
USB 3.0 (COMPATIBLE WITH USB 2.0 DEVICES)

TRANSFER SPEED
UP TO 450MB/S*

SECURITY
OPTIONAL 256-BIT AES ENCRYPTION WITH PASSWORD SETTING**

DIMENSIONS (W X H X D)
71.0 X 9.2 X 53.2 MM

WEIGHT
30G

WARRANTY
LIMITED 3-YEAR^

*Performance benchmark product: T1 (500GB). Performance can vary depending on host configuration and test software.

**Users can select security option during the initial registration process (For more details, please refer to the manual).

^See http://www.samsung.com/au/support/warranty for further information.

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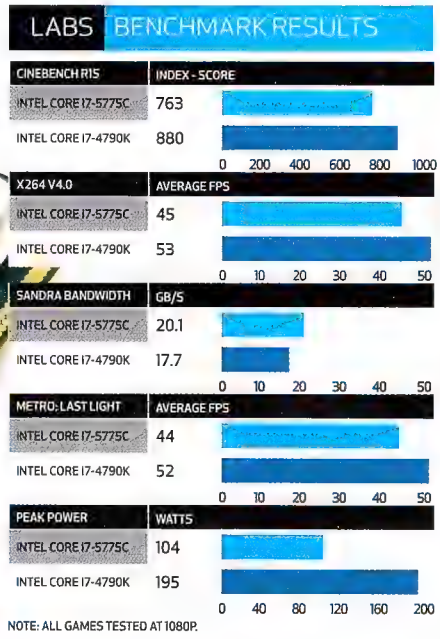


Intel Core i7-5775C

Desktop Broadwell is here. Was it worth the wait?

Intel's fifth-gen desktop CPU, the Core i7-5775C, is finally in our test benches. So what is Broadwell? It's a 14nm production process die shrink on what's still essentially Haswell CPU tech, giving serious power efficiency to the chips. That's why they're first and foremost of interest to the mobile crew, although they retain some interest on the desktop because you also get the very best in processor graphics.

This is the first time the Iris Pro level of graphics has appeared in socketed form, and compared with the HD Graphics 4600 parts in the latest Haswell Devil's Canyon chips, the Iris Pro 6200 has more than twice the execution units (EUs).

Elsewhere, you're looking at classic Core i7 stats – four cores with eight threads. Because this a 'C' class chip, you only get a clock speed of 3.3GHz with a max turbo of 3.7GHz, although it retains unlocked multipliers to aid overclocking.

Technologically speaking, the i7-5775C is the top CPU in Intel's standard desktop lineup. For the next few weeks, anyway. So what makes it a relevant upgrade to the cheaper Devil's Canyon Core i7?

On the face of it, there seems to be no reason to upgrade from your current Haswell i7, and probably most existing i5 chips. The i7-5775C is a good chunk more expensive than the i7-4790K, and in terms of straight clock speed and thus gaming performance, it's a bit of a bust. In our benchmarks, X264 and Cinebench gave a landslide victory to the last-gen CPU.

The bright spot is in the memory bandwidth figures. The Broadwell chip shows big improvements, topping anything we've seen outside of Ivy Bridge-E processors. And what of overclocking? Sadly, we couldn't hit the standard 1GHz overclock that Intel CPUs often offer. Boosting it from a 3.3GHz base up to 4.2GHz is no mean feat and does improve performance, but nowhere near enough to worry the existing top Haswell chip in straight performance.

But this isn't where Broadwell is meant to compete. It's a low-power i7 with high-end graphics and limited overclocking. At stock speeds, the peak power we were seeing during Cinebench tests was just 104W, with the CPU only a shade over 50°C. But even when overclocked to 4.2GHz, the CPU was still under 60°C and only drew another 50W at maximum. That's some seriously impressive efficiencies. This eight-threaded CPU is barely drawing the same power as last-gen quad-thread parts.

In terms of its graphics performance, having more than twice the EUs of the Haswell HD Graphics 4600 – 48 compared to 20 – the Iris Pro 6200 delivers a huge performance boost. Gaming at top 1080p settings goes from practically slideshow levels to genuinely playable.

As a preview of what we can expect from the next-gen Skylake family, this 14nm die shrink is darned impressive. But the thought of spending $569 on one is beyond the pale. Even with the excellent Iris Pro graphics finally hitting socketed CPUs, we struggle to see who would actually consider picking one up.

This is a chip that might have looked impressive last year, and maybe even today if it had a higher clock speed and lower price. But that's not the case, so there's little reason to consider it.

Dave James

Verdict

Features	★★★★
Performance	★★★
Value	★½

Excellent power efficiency, impressive low temps and a great CPU graphics core, but it's way too expensive.

★★½

LAPTOP

FROM $1,499; AS TESTED, $2,100 | WWW.HP.COM/AU

HP Spectre x360

A sublimely thin two-in-one laptop that's almost perfect.

The Spectre x360 might be the first transforming laptop to finally strike the perfect balance between laptop and tablet. Unlike most other hybrids, this 13.3-inch machine looks like any regular laptop, but in one quick and smooth motion, you can flip the screen back 360° to turn it into a full-on Windows 8.1 tablet.

If Lenovo and Apple ever had a baby, it would be this. HP has blended the best elements of the MacBook Air's aluminium body with the rotating hinges from Lenovo's Yoga series of convertible machines to make a gorgeous computing device. The outside shell is minimalistic with almost no embellishments on its plain, anodised aluminium chassis and it's only 16mm thick.

But while this is one of the smallest hybrid laptops ever made, the weight is still a concern: at 1.47kg, it's still quite unwieldy as a tablet. That makes it hard to hold for long periods, but once you start using them, the flexibility of the alternate physical configurations proves useful.

HP has also come up with a hinge design that blends in. So instead of noticing the hinges, your attention is drawn to the unusually wide trackpad. Nearly double the width of a traditional pointing device, the Spectre x360 offers an expansive and smooth surface to glide your fingers over. It's also accurate to a millimetre, thanks to Microsoft's Precision trackpad software. We did have some issues with accidental taps when using the keyboard, but its palm rejection is generally pretty good.

The keyboard follows a traditional layout with a white backlight to help you see the keys in the dark. The keys feel a bit mushy and don't offer the crisp typing experience of a MacBook, but the typing experience on is more than serviceable, and most users won't notice unless they're sticklers for the very best.

Hands down, the HP Spectre x360 has one of the best screens of any laptop we've tested, offering some of the best viewing angles we've ever seen – backed up by a wide colour gamut and a very bright panel. While this two-in-one comes with a glossy, glass-fronted display, we had almost no problems using it outside in the sun. This is a rarity and makes it usable in any scenario.

Like the little engine that could, the Spectre x360 can deftly take on any general-usage task, from simple web browsing to playing a virtual hand of *Hearthstone* with the quality settings at their highest. And you can squeeze a surprising amount of battery life out of this petite 13-inch convertible laptop – in PCMark 8's tough Home test, it managed a solid 4:38hr

That said, this isn't a gaming machine: don't expect to it to play much more than low-impact indie games.

HP and Microsoft have put together one of the sharpest-looking two-in-one convertible laptops ever. Without any foreknowledge, most people would think the HP Spectre x360 was nothing more than an attractive, all-aluminium laptop. Thanks to a pair of well-engineered gear hinges, the transforming element of this laptop adds almost no extra weight, awkward proportions or clunky mechanics. Instead, the x360 only inherits the added flexibility of a two-in-one machine, letting you use it more ways than just on your lap. It's well worth a look over the many, many other hybrids.

Kevin Lee

Verdict

Features	★★★★½
Performance	★★★★
Value	★★★★

It's not as quick as a Surface Pro 3, but this reasonably priced and lightweight Windows 8.1 unit charms.

★★★★½

apc RECOMMENDS

LABS BENCHMARK RESULTS

General system performance

PCMARK 8 - HOME	SCORE
GIGABYTE P55W V4	3,843

0 1,000 2,000 3,000 4,000 5,000

X264 HD BENCHMARK	5.01 (AVG FPS)
PASS 1	56.6
PASS 2	14.1

0 20 40 60 80 100

Gaming performance

3DMARK - CLOUD GATE	SCORE
GIGABYTE P55W V4	19,539

0 5,000 10,000 15,000 20,000 25,000

1080P, ULTRA	AVG FPS
METRO: LAST LIGHT	56.7
BIOSHOCK INFINITE	68.9

0 20 40 60 80 100

Battery life

1080P, ULTRA	HOURS:MINS
PCMARK 8 HOME	1:58
PEACEKEEPER - WEB SURFING	2:27

0 1 2 3 4 5

LAPTOP

$2,300 | WWW.GIGABYTE.COM.AU

Gigabyte P55W v4

A top gaming laptop at a reasonable price? What's the catch?

When it comes to gaming-capable laptops at this price point, the P55W v4 faces some stiff competition. Yet based purely on specs, it certainly gets off to a solid start: it's about the cheapest 15.6-inch laptop you'll find that packs a top-end Core i7 CPU, GeForce GTX graphics chip and both an SSD and secondary hard drive for storage. And those aren't budget parts – they're basically just a step or two down from the top spec, meaning overall performance is first-rate.

The all-important gaming performance was bang on what we've seen from other laptops sporting the Nvidia GeForce GTX 970M. With Ultra graphics settings at the screen's native 1080p resolution, you'll get around 40-50fps in newer titles and 70-80fps in less-demanding games. Those are definitely playable frame rates, and you can often double them by turning down the detail settings to High.

The CPU is one of Intel's latest fifth-generation Core i processors – the speedy quad-core i7-5700HQ. It outperforms the previous-gen i7-4710HQ (as seen in many other laptops around this price) by around 5-10% in CPU-intensive tasks, like media encoding.

Even the storage is better than average. While that 128GB main SSD (a well-specced SATA 6Gbps model) is a little smaller than we'd ideally have liked (256GB would at least give you some room for games, which will realistically need to be stored on the secondary 1TB Hitachi storage drive) just having an SSD at this price really is a bonus – it makes a huge difference to boot time and overall system responsiveness.

Although the P55W's charcoal-grey exterior is entirely plastic, this is still a handsome laptop – and in some ways, it looks a bit better than mixed-finish laptops (sporting metal on the lid and keyboard deck) because its finish is more consistent. Even the orange 'racing stripes' – new to this v4 model – aren't too ostentatious; they're enough to give it some personality without screaming 'I'm a gaming laptop!'

The P55W does have some drawbacks, though we wouldn't call any of them serious. It's not particularly portable, for example. You could carry it around if needs be, but at 2.63kg for the laptop and another 700g for the charger, it's venturing into the 'pull your shoulder off' zone.

And there are a couple of spots where the P55W's performance could have been better – specifically, battery life and heat. Unplugged, this unit can stretch to 2.5 hours in lighter workloads (like web surfing), but that drops to under 2 hours when you push it in more demanding tasks. And speaking of, the CPU hits a toasty 95°C under load, while the GPU reaches 83°C, so the cooling system here isn't the most efficient – compare those to the similar Venom Blackbook 15's 74°C and 70°C, respectively, and there's a pretty stark difference. Regardless, the P55W v4's temperature measurements are technically within the spec for those parts, although it's worth noting that they will also heat up surrounding components.

Some shortcomings are to be expected when you're getting this high-value hardware, of course, and none of these are what we'd classify as deal-breakers. If you're on a tight budget and you want all the performance you can get, this one's a solid choice.

Dan Gardiner

Verdict

Features ★★★★½
Performance ★★★★
Value ★★★★½

Punches above its weight in terms of specs for dollars, but heat and battery life could use improvement.

★★★★½

GAMING LAPTOP

$5,500 | AU.MSI.COM

MSI GT80 Titan

It's certainly epic, but is this 'titan' really god-like, or closer to the ill-fated Titanic?

Any way you slice it, it's hard to call MSI's GT80 anything but utterly ridiculous – though not in a derogatory sense. MSI calls this the world's 'slimmest 18.4-inch gaming notebook' – but at 4.9cm thick and weighing 4.5kg, that claim doesn't really add up to much. It's hard to call it a 'lap top', let alone portable. This is a gaming machine through and through, with a brightly-backlit keyboard, black-and-red colour scheme with giant dragon decals and twin GeForce GTX 980Ms under the hood, this one's got plenty of l33t gaming cred (if you're looking for that sort of thing).

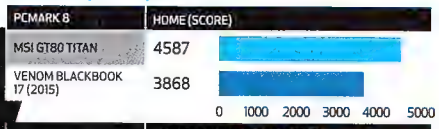
While the mechanical keyboard (with brown Cherry MX switches) is the most-obviously ostentatious feature pretty much everything else is over the top, too. Even a little experimental in places. The whole keyboard deck, for example, is oddly designed. It puts the mechanical keys right at the front and wedges a portrait orientation trackpad next to it. That trackpad can also switch to a backlit numpad, so you've essentially got a full-sized keyboard. Also of note is that there's no left Windows key – potentially great if you're a gamer, not so much if you're used to keyboard shortcuts. The tall trackpad is a bit problematic in use. It's so narrow the sensitivity needs to be up quite high in Windows 8. We constantly found ourselves accidentally swiping open the charms menu. But then, with this behemoth, the assumption is that you'll probably have a mouse plugged in anyway. The GT80's display is a 1080p matte-finish job (you can't get higher-res laptop panels at this size yet) and it's quite good for gaming, keeping reflections to a minimum and delivering great contrast. Colours on our test unit were good – fairly neutral, with a very slight yellow/green cast.

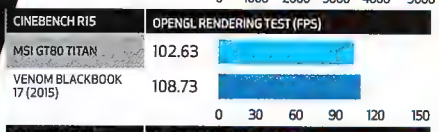
Performance on this machine is, as you'd expect, top notch. CPU performance, driven by a Core i7-4820HQ is almost at desktop levels, and the four-drive RAID 0 storage system gives you a fantastically-responsive experience, with very fast loading times. (There's also a secondary 1TB mechanical drive for storage duties.) And those two 980M GPUs deliver some of the fastest framerates we've seen on a portable. While SLI doesn't always deliver twice the performance – sometimes there's no increase – it does mean you're getting 100fps+ framerates in most games at Ultra settings. Battery life was better than expected around 2 hours for typical day-to-day tasks and watching video. The GT80's thermals were better than we've seen in other gaming laptops, but there's still room for improvement. The GPUs peaked at 70°C and 84°C respectively. The hotter GPU sits closer to the CPU, which itself can get up to 92°C. So where does that leave us, on the whole? At $5,500 and over 5kg including charger, it has a narrow potential market (children of one-percenters?). It largely lives up to its on-paper potential, however, and MSI's about to refresh this model with a 5th-gen Core i chip (the i7-5950), double the SSD storage and upgrading the DVD writer to a Blu-ray one. Those additions make for a much-more well-rounded offering, one we'd recommend waiting for. ■

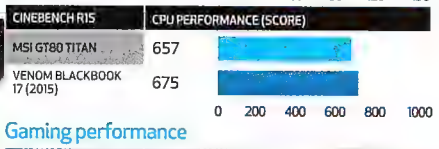
Dan Gardiner

LABS BENCHMARK RESULTS

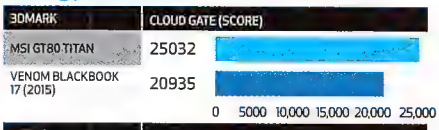
General system performance

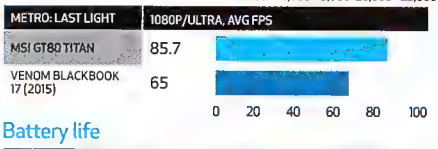




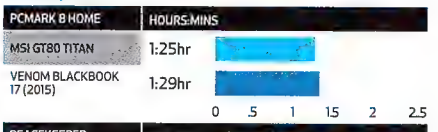


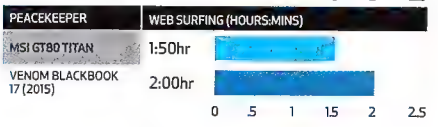
Gaming performance





Battery life





Verdict

Features ★★★★½
Performance ★★★★½
Value ★★★

It's over the top, yes, but the GT80 does live up to its ostentatiousness in both performance and features.

★★★½

"When it comes to image quality, this new IPS model whips the RoG Swift raw with the spiky end of a DVI cable. It's an absolutely gorgeous screen."

apc HOT PRODUCT

MONITOR

$999 | ASUS.COM/AU

ASUS MG279Q

Behold, the messiah of gaming monitors.

ASUS's new MG279Q ticks a lot of boxes. It's a 27-inch IPS model, with 2,560 x 1,440 pixels, 144Hz and adaptive syncing. It's not a super-wide panel with 3,000-plus horizontal pixels. Nor is it a 4K box. But 2,560 x 1,440 pixels is arguably where the sweet spot is right now in terms of matching pixel grids with GPU power – 4K panels are marginal for smooth rendering on a single GPU.

Intriguingly, you get all this for $100 less than ASUS's familiar RoG Swift monitor. That's similar in many regards. It's 27 inches, 2,560 x 1,440 pixels at 144Hz and with adaptive sync. But it differs critically in two regards. The RoG Swift's adaptive sync is Nvidia-flavoured G-Sync tech and its LCD is a TN item. This screen sports AMD's competing FreeSync tech and rocks an IPS panel.

When it comes to image quality, this new IPS model whips the Swift raw with the spiky end of a DVI cable. It's an absolutely gorgeous screen. The colours are as good as we've seen pretty much anywhere on any screen. It's a delightful combination of accuracy and saturation, at the same time as seeming perfectly natural and not remotely forced, the latter being a routine issue with VA panels, which often look punchy but thoroughly OTT.

Where things get complicated, both in terms of the comparison with the Swift and in terms of actual technical implementation, is when it comes to adaptive sync tech. Adaptive sync means aligning the refresh rate with the output of your graphics card for improved smoothness and an end to screen tearing. We know AMD's FreeSync technology is a little rough around the edges, and unfortunately, that remains the case here. For starters, FreeSync doesn't currently play nicely with response-enhancing overdrive tech,and you get some nasty inverse ghosting with FreeSync enabled.

The MG279Q is actually a good display to get to grips with the problem, thanks to a wide range of adjustment for the overdrive setting, which is accessed via ASUS's excellent OSD. Set it to minimum and there's little to no ghosting, but a fair bit of blur. Crank it up to max and the ghosting is utterly grim. Around the 40% setting cuts the blur nicely and doesn't add any noticeable ghosting.

Next up, the FreeSync in this implementation is also limited to a maximum refresh rate of 90Hz. That's enough to get much of the smoothness benefit of high refresh rates, but not all of it. Of course, you could argue that once you're up over 100Hz, the benefits of adaptive sync are marginal. So if your graphics card is up to it, running with FreeSync disabled and the panel set to full 144Hz reheat could be the answer.

Casting a shadow over all of this is the fact that you'll need an AMD GPU to run FreeSync, while G-Sync screens like the Swift need Nvidia graphics. Given that monitors are generally pretty long-term purchases, that makes for a potential GPU vendor lock-in that leaves us more than a little bit uncomfortable. Not that this is ASUS's fault. However, it's certainly worth bearing in mind.

That said, you're not really paying extra for the FreeSync capability. So view the ASUS MG279Q as mainly a 144Hz IPS panel and it's still a very appealing proposition. The best gaming monitor yet? Very possibly.

Jeremy Laird

Verdict

Features	★★★★½
Performance	★★★★½
Value	★★★★

IPS with 144Hz at last and FreeSync is essentially freebie, but it's not cheap.

★★★★½

msi®

GAMING G SERIES

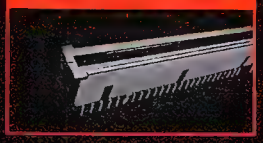
Z170A GAMING M7

Subvert Your Imagination

DDR4-3400(OC)

TWIN-TURBO M.2

PCIEX16 STEEL ARMOR



USB3.1 GEN.2 (TYPE A&C)

TITANIUM CHOKE

USB 3.1 GEN 2 TYPE-C TYPE-A | Nahimic Audio Enhancer | KILLER ETHERNET E2400 | XSplit | Gamecaster VERSION 2 | MILITARY CLASS | Windows 10 Compatible

VIC

PC Case Gear	03 9551 0889	pccasegear.com
Centre Com Sunshine PTY	03 8311 7600	centrecom.com.au
EVA Tech	03 9020 7017	evatech.com.au
Landmark Computers	03 9701 3366	lmc.com.au
CPL	03 8542 8688	cplonline.com.au
BudgetPC	03 9541 9000	budgetpc.com.au
Scorptec	03 8561 3206	www.scorptec.com.au
TECS	03 9602 3499	www.tecs.com.au
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PCD International	03 5222 5180	www.pcdi.com.au
Cnet technology Preston	03 9416 8886	www.prestontech.com.au

NSW

Dcomp	02 4721 3457	dcomponline.com.au
PC Meal	1300 366 866	pcmeal.com.au
Mwave	1300 727 446	mwave.com.au
IJK International Pty Ltd	02 9745 0877	ijk.com.au
JW Computers	1300 592 667	jw.com.au
Digital Star	02 8748 6888	digitalstar.com.au

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Austin Computers	08 9201 2788	austin.net.au
PLE Computers	08 9309 4771	ple.com.au

QLD

Computer Alliance Pty Ltd	07 3420 3200	computeralliance.com.au
Game Dude Pty Ltd	07 3387 1500	gamedude.com.au
Umart Online	07 3369 3928	umart.com.au
Digital Matrix Computers	07 4779 8054	digitalmatrixcomputers.com.au

SA

Allneeds Computers	08 8211 8661	www.allneeds.com.au

TAS

Taspro Computers	03 6424 1911	taspro.com.au

MSI Australia

GAMING.MSI.COM

apc RECOMMENDS

SSD

$1,299 | WWW.SAMSUNG.COM/AU

Samsung 850 Pro 2TB

Large and agile? Samsung takes a brave step forward for the future of SSDs.

Performance or capacity. That's been the dichotomy that's dominated data storage since the first SSDs appeared. But now Samsung has launched the first consumer 2TB SSDs. The 850 Pro combines the speed of solid-state flash with the multi-terabyte mass storage.

How has Samsung done it? It's largely down to its 3D V-NAND memory, the trailblazing flash memory tech that sees memory cells stacked atop one another, giving it the ability to squeeze much more capacity into a given area. Using multiple layers of memory cells also takes the pressure off the need for each layer to absolutely max out capacity. Where Samsung's previous-gen 840-series drives sported NAND memory with tiny 19nm transistors, the 850 series uses 40nm tech.

To achieve the 2TB capacity, Samsung had to create a new controller chip, as it says its existing MEX controller had limitations when it comes to really high capacities. Consequently, the new 2TB has a new controller, the MHX.

Samsung's performance claims suggest the increased capacity doesn't incur any performance downsides, with 550MB/s sequential reads, 520MB/s sequential writes, plus 100,000 read and 90,000 write IOPS.

Where things get really interesting is durability. The 2TB absolutely does not disappoint. Samsung provides a mega 10-year warranty, along with expectations of 300TB-worth of writes. Wow.

However, the elephant in the room is that the 850 Pro is a plain, old SATA drive, which means it's limited to a real-world peak performance of 550MB/s. That's simply a function of the 6Gbps limitation of the SATA interface.

If you're upgrading an existing system, that shouldn't be a problem. You may not have any M.2 slots in your PC, anyway. But as the storage solution for a new PC you're building, or for an existing system with M.2 support, the limitations of SATA are more of a problem. Compared with the near-2GB/s of bandwidth of M.2 drives, the 550MB/s top whack of a SATA drive makes even this 2TB drive look old hat.

Samsung's figures are borne out in testing as well. In terms of raw sequential throughput and random access performance, it's simply bouncing off the SATA interface limitations. More interesting is the fact that the 850 Pro clocks in with probably the fastest time we've seen for a SATA drive in our real-world 5GB file compression test.

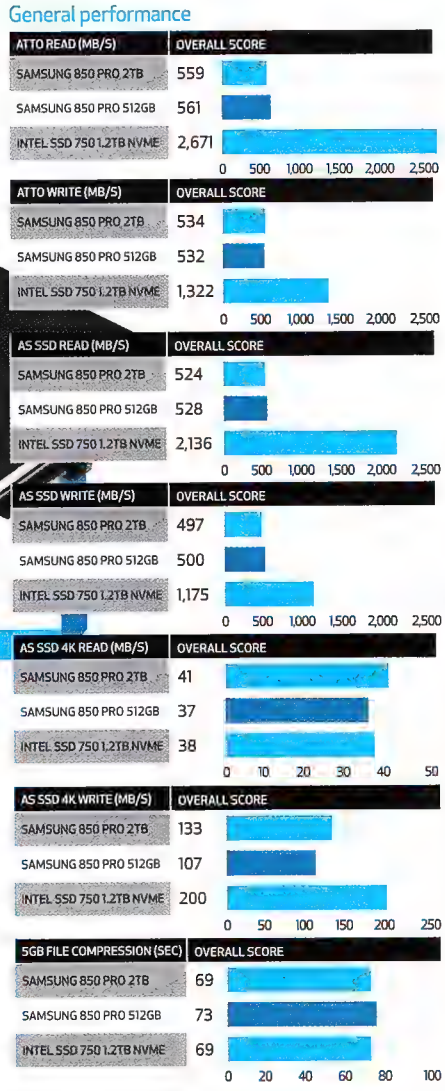
How you view this drive's performance ultimately comes down to whether you're in the market for an M.2 or a SATA unit. It's great for SATA, but it can't get close to a drive built around the latest standards. But if you need the biggest and best SATA SSD, it's a killer.

Jeremy Laird

LABS BENCHMARK RESULTS

Tested with an Intel Core i7-4790K on an ASRock Z97 Extreme4 motherboard, with 8GB of Corsair Dominator DDR3 at 1,600MHz.

General performance


ATTO READ (MB/S)
OVERALL SCORE
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SAMSUNG 850 PRO 512GB 561
INTEL SSD 750 1.2TB NVME 2,671
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ATTO WRITE (MB/S)
OVERALL SCORE
SAMSUNG 850 PRO 2TB 534
SAMSUNG 850 PRO 512GB 532
INTEL SSD 750 1.2TB NVME 1,322
0 500 1,000 1,500 2,000 2,500
AS SSD READ (MB/S)
OVERALL SCORE
SAMSUNG 850 PRO 2TB 524
SAMSUNG 850 PRO 512GB 528
INTEL SSD 750 1.2TB NVME 2,136
0 500 1,000 1,500 2,000 2,500
AS SSD WRITE (MB/S)
OVERALL SCORE
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SAMSUNG 850 PRO 512GB 500
INTEL SSD 750 1.2TB NVME 1,175
0 500 1,000 1,500 2,000 2,500
AS SSD 4K READ (MB/S)
OVERALL SCORE
SAMSUNG 850 PRO 2TB 41
SAMSUNG 850 PRO 512GB 37
INTEL SSD 750 1.2TB NVME 38
0 10 20 30 40 50
AS SSD 4K WRITE (MB/S)
OVERALL SCORE
SAMSUNG 850 PRO 2TB 133
SAMSUNG 850 PRO 512GB 107
INTEL SSD 750 1.2TB NVME 200
0 50 100 150 200 250
5GB FILE COMPRESSION (SEC)
OVERALL SCORE
SAMSUNG 850 PRO 2TB 69
SAMSUNG 850 PRO 512GB 73
INTEL SSD 750 1.2TB NVME 69
0 20 40 60 80 100

Verdict

Features ★★★★½
Performance ★★★★
Value ★★★★½

Serious storage; stellar endurance; great for laptops; fast for SATA.

★★★★½

SSD

$480 | WWW.OCZ.COM

OCZ Trion 100 960GB

Does OCZ's affordable new SSD stack up in a cut-throat market?

OCZ's new budget-oriented SSD comes in 120GB, 240GB, 480GB and 960GB flavours, with the latter in our Labs this month for testing. Notably, its OCZ's first fully Toshiba-based SSD since it was acquired by the Japanese company last year. While Toshiba does the building, OCZ performs the testing and validation. The Trion uses second-gen 128Gbit A19 TLC NAND flash, coupled to a Toshiba TC58 controller. The drive uses the standard 7mm thick/2.5-inch form factor, as well as the SATA 6Gbps interface.

We tested read and write speeds with AS SSD and CrystalDiskMark. Sequential read and writes are fast at 539/516MB/s, but essentially capped by the SATA interface, like most modern SSDs. The Trion is rated for 90,000/54,0000 (read/write) IOPS, but random 4K performance isn't quite as good as you see on MLC-based SSDs. Still, it's real-world performance is solid overall for a budget SSD. As is typical, read and write speeds are slightly slower on the low-capacity drives. Endurance on the 960GB Trion over the three-year warranty period is excellent at 240TB total, or 219GB a day, though the smaller drives offer less. The Trion 100 does support low power state idle, but no hardware encryption.

While it offers acceptable bang for buck, there's nothing here that really stands out from the crowd. Hopefully prices will drop a little to make it more competitive. The 960GB model will set you back around $480, the 480GB is $249, the 240GB $129 and the 120GB just $79.

Lindsay Handmer

Verdict

A solid SSD that faces stiff competition from other affordable drives.

★★★½☆

MOUSE

$180 | WWW.RAZERZONE.COM/AU

Razer Mamba Tournament Edition

Setting a new bar for sensitivity.

This latest Mamba proves, there's more to customisation than how big a mouse is. It's not too different from the original, albeit with a slightly less flared design and it's wired, with a 2.1m USB cable.

The Philips laser sensor boasts precision up to a stunning 16,000dpi, which can be adjusted in 1dpi increments. You can also configure from three to five different precision levels and flick between them using the two buttons that sit behind the mouse wheel. The Synapse software enables you to change the polling rate as well – to either 125,500 or 1,000 times a second – as well as configuring separate X and Y sensitivities.

There are 11 buttons that can be assigned to various actions using Synapse. The mouse wheel is home to five of these, as it rocks left and right, scrolls up and down – and you can click it.

The Mamba TE's sports RGB illumination on the left and right sides of the main body, on the Razer logo and on the scroll wheel. You can independently set any of these to the colour of your choice, set up animated waves or have it flash when you click a button.

We found the Mamba TE to be an impressive gaming mouse. It's a little lighter than we usually prefer (and there's no way of adding bulk), but we soon got used to it. It's smooth and precise, and we found it comfortable after long gaming sessions.

Which is all very glowing, apart from the price. Yes, $180 is a lot for a mouse, but the Mamba TE is well worth considering.

Alan Dexter

Verdict

Despite cheesy lighting and a high price, this is a fantastic-performing gaming mouse.

★★★★½

$175 | WWW.PHANTEKS.COM

Phanteks Enthoo Evolv ATX

A feature-packed modder's dream.

This Evolv ATX is pricey, but then you take a look at what's included and the stunning build quality that's been achieved, and you begin to appreciate what Phanteks has pulled off at this price.

The case is made up of solid 3mm-thick aluminium panels situated on top of an all-steel chassis to give it a hefty, solid dependability. There's little to no flex in any of the panels (including the windowed side panel), all of which have sound-dampening foam on the joins, preventing any excess noise from vibration.

The case is incredibly modular. Supporting up to seven 3.5-inch drives (five with the included brackets) and four 2.5-inch drives (two included), it's neatly partitioned into two separate compartments for your motherboard and power supply, with plenty of room for cable management, including some Velcro cable straps and a multitude of tie-down points as well.

There's even a sliding radiator bracket in the top that you can remove for easy installation of all-in-ones or radiators, hinged and removable side-panel doors, and support for water-cooling components.

As far as negatives go, the front I/O consists of two USB 3.0 ports and a mic and headphone jack. It would've been nice to have seen an additional two USB ports here. Additionally, while the perforated floor separating the power supply from the motherboard allows for ample airflow, it would've looked a lot cleaner if the panel was solid.

All in all, it's definitely worth buying for those who want a premium case with plenty of room inside.

■ Zak Storey

Verdict

Packed with features and has stunning build quality, though the front I/O could be better.

★★★★½

$150 | WWW.FRACTAL-DESIGN.COM

Fractal Design Define S

Has liquid cooling support in spades.

We know what you're thinking. Yet another Fractal Design Define mid-tower case looking just like all the others. Well, before you nod off, the Define S has a few tricks up its sleeve.

From the outside, it may look like its siblings, but on the inside, Fractal has designed the internal layout with liquid-cooling support in mind. For a start, there are no conventional drive cages; instead, there's three drive trays housed on the rear of the backplate. Each tray supports either 3.5-inch or 2.5-inch drives, while there's also two dedicated 2.5-inch trays to the rear of the motherboard tray.

Where the drive cages would normally be found, there's a big, empty space. At least until you look closer. The backplate has been drilled for mounting a liquid-cooling reservoir (mounts are included) and the base can support many different types and sizes of pump units.

As for radiators, the Define S can support the odd one or four, and it features Fractal's ModuVent covers on the top panel. All of the covers can be removed to allow fans to be fitted.

Unfortunately, there are only two USB 3.0 ports in the I/O bay and there's no integrated fan controller.

A nice design touch is the small hole at the bottom of the motherboard backplate, close to where the audio header is situated – it means the front audio cable runs neatly behind the backplate, along with all the other cabling.

Luckily, despite the lower price tag, the Fractal Design attention to detail and superb build quality remain as high as ever.

■ Simon Crisp

Verdict

Offers superb build quality and liquid cooling support at an excellent price.

★★★★½

SMARTPHONE

$929 | WWW.LG.COM/AU

LG G4

The G4 combines technology and leather into one sleek package.

An elegant and attractive flagship phone, the LG G4's main point of difference is its detachable leather backing, which makes it instantly recognisable among the increasingly identical horde. The G4 also packs a longer battery life, improved camera and upgraded screen over its G3 forebear. And, if leather's not your style, it comes with an alternative polycarbonate back, too.

The G4's battery is also removable, which explains the need for a plastic cover (easier to remove and less likely to break than a metal one). Its gorgeous QHD 5.5-inch LCD screen is exceptionally clean and even-toned, and vies for top spot with Samsung's Galaxy S6 as the best on the market. LG's making a big deal about the camera prowess of the G4, and rightly so: there's a 16MP snapper on the rear, and it's fused with a f1.8 aperture that's designed to deliver spectacular low-light shots. On top of that, LG has added in a huge amount of control to the camera. Quite frankly, it's up there with the best we've tested.

In our benchmark tests, the LG G4 performed quite admirably, but it's a little behind other flagships. This is by no means a slow device and it'll handle anything you can throw at it, although there are faster options. Battery life is also impressive, and when you add in the ability to switch the G4's battery out for a spare, you shouldn't find yourself running out of juice too often.

Sexy and sophisticated, this handset is sure to turn a few heads.

■ Stephen Lambrechts

Verdict

Not everyone is going to love its design (we do), but they will love the G4's incredible screen, camera and processing power.

★★★★½

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software

» APPS FOR ALL THE PLATFORMS

Windows SOFTWARE

Pale Moon

A speedy web browser that's more than just a Firefox clone...

FREE | WWW.PALEMOON.ORG

Nearly every web browser aims to strike a balance between features and speed, and provide a more robust and responsive interface and rendering engine. Yet Pale Moon is very special, and in many ways unlike other lesser-known browsers. That's due to the fact that it was forked from Mozilla Firefox in 2009, in the 3.6 version era, and since then it's claimed to be faster and more secure than Firefox. Reading the published FAQs and other materials on the project's website takes time to discover in what particular way Pale Moon is better, because both advertise themselves in a similar way to each other.

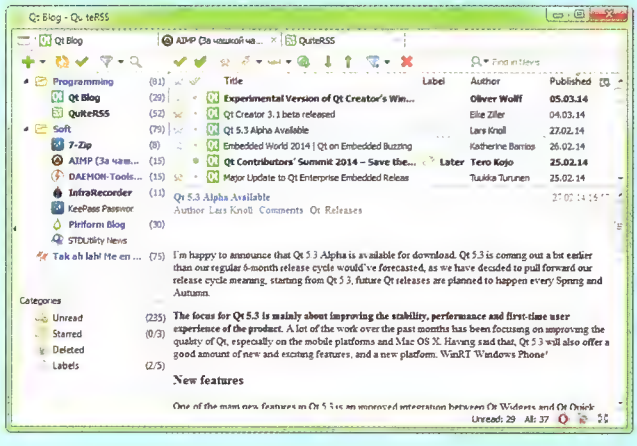
It boils down to Pale Moon being a Firefox clone with some significant improvements, with most of them focused on speed, such as discarding support for ancient CPUs for the sake of in-depth use of SSE2 and other modern features available since the late Pentium IV (with 64-bit support). It also cuts out accessibility input options, tabs grouping, WebRTC, parental control, PDF reader and some rarely used APIs. The end result is a speedy web browser for general use, which looks like classic pre-Australis Firefox (before v28), but that still supports many Firefox extensions.

The Pale Moon developers do try to maintain compatibility with parent extensions, despite Pale Moon drifting more and more away from its Mozilla origins. Pale Moon even provides its own sync server, which, it claims, provides a more secure approach to synchronizing data, without a focus on the "future commercial endeavours of the Mozilla Corporation"...

Alexander Tolstoy

QuiteRSS

FREE
QUITERSS.ORG


Qt Blog
QuiteRSS
Programming
Qt Blog
QuiteRSS
Soft
7-Zip
AIMP
DAEMON Tools
InfraRecorder
KeePass Password
Piriform Blog
STDUtility News
Title
Author
Published
Experimental Version of Qt Creator's Win...
Oliver Wolff
05.03.14
Qt Creator 3.1 beta released
Elke Ziller
04.03.14
Qt 5.3 Alpha Available
Lars Knoll
27.02.14
Embedded World 2014 | Qt on Embedded Buzzing
Katherine Barrios
26.02.14
Qt Contributors' Summit 2014 – Save the...
Tero Kojo
25.02.14
Major Update to Qt Enterprise Embedded Releas
Tuukka Turunen
25.02.14
Qt 5.3 Alpha Available
Author Lars Knoll Comments 0 Releases
I'm happy to announce that Qt 5.3 Alpha is available for download. Qt 5.3 is coming out a bit earlier than our regular 6-month release cycle would've forecasted, as we have decided to pull forward our release cycle meaning, starting from Qt 5.3, future Qt releases are planned to happen every Spring and Autumn.
Categories
Unread
Starred
Deleted
Labels
The focus for Qt 5.3 is mainly about improving the stability, performance and first-time user experience of the product. A lot of the work over the past months has been focusing on improving the quality of Qt, especially on the mobile platforms and Mac OS X. Having said that, Qt 5.3 will also offer a good amount of new and existing features, and a new platform, WinRT Windows Phone
New features

Instead of surfing through endless tech news sites, it's much better to use some dedicated aggregation software. Since 1995, RSS has proven to be the most comfortable method of delivering news and articles. It's grown from Rich Site Summary in the early days to Really Simple Syndication at present. Many websites make their own RSS feeds, which are designed as custom XML pages on specific URLs. Though the contents of an RSS feed can be viewed in any web browser, it's primarily designed to be used with RSS clients, and there are plenty of them about, both for web-based and standalone use.

QuiteRSS is one of the latter. It's feature-rich, yet it doesn't get in the way unless, of course, you want it to. The top-left pane shows the list of feeds and a toolbar to add new feeds or modify existing ones. Just below there's a tree of coloured labels, which let you mark feeds and then easily find them. The main part of the window resembles an email client and displays the list of news from the feeds and shows the contents of the currently-selected news item. The lower pane presenting the contents is a fully featured web browser – you'll notice that once you click on any link in the body of the news. It has the AdBlock extension and enables you to switch whether images are displayed, though it won't let you go to a custom web address in the input bar. Instead, you can use the 'globe' button on the toolbar to open the URL you're at in your default web browser.

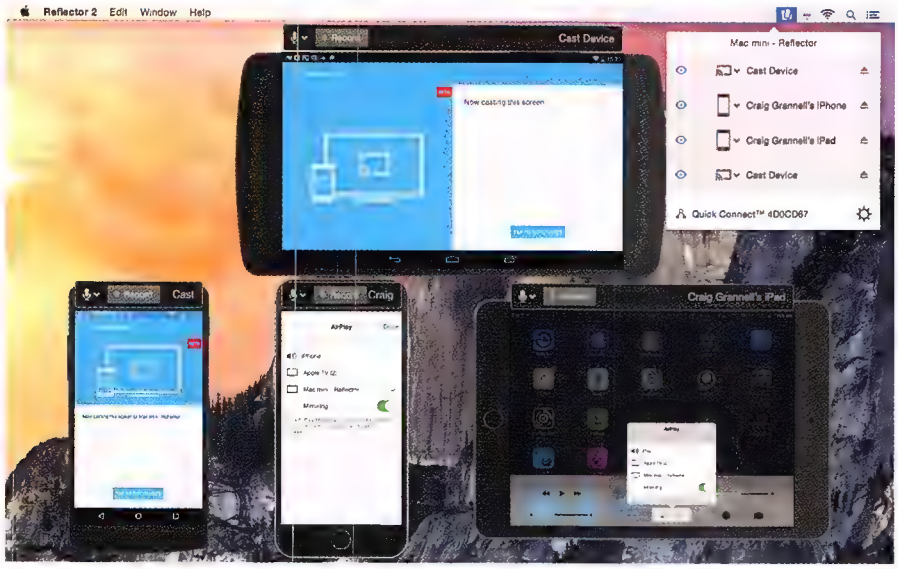
QuiteRSS has a very clean and easy-to-use interface, it supports classic and newspaper viewing modes, advanced searching tools (including searching in links), several selection methods (such as stars, labels and filtering) and lots of precise controls over the way the notification messages work.

Alexander Tolstoy

Reflector 2

Get your iOS and Android device displays mirrored on your Mac's screen.

US$14.99 | AIRSQUIRRELS.COM/REFLECTOR



Reflector bills itself as "the last receiver you'll ever need", enabling real-time mirroring of iPhone/iPad displays, and Google Cast-compatible Android devices. We quickly got four devices (iPad Air, iPhone 5S, Nexus 4 and Hudl 2) working simultaneously.

By default, connected devices are surrounded by a 'frame' representing their hardware, which differentiates mirrored content. Reflector rescales virtual devices, so all can be shown at once, but annoyingly overlays other apps (these settings can be adjusted). A single device can be 'emphasised', shrinking others, or you can show/hide specific items. Full-screen mode shows all devices, rather than just one.

Performance was great with little or no lag, even when playing games, but getting content across from broadcast media apps seemed impossible.

Reflector can also record any device and add a voiceover from a mic input. Output was mostly fine during testing, bar the odd dropped frame, but videos are restricted to TV-oriented outputs.

Still, ease of use makes this one of our favourite device receivers.

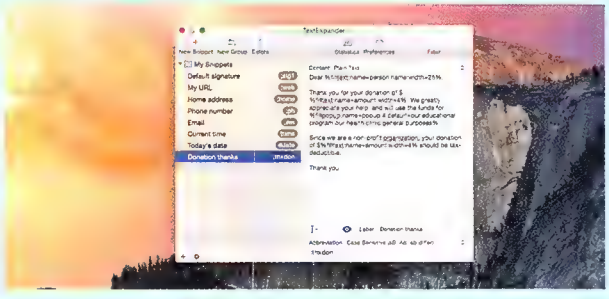
Craig Grannell

TextExpander 5

US$44.95 | SMILESOFTWARE.COM

TextExpander enables you to define phrase shortcuts that, when typed, it replaces with some other content – that can be a spelling correction, emoji, a multi-line address, a snippet of code, or a combination of text and images. You might set ';esig' to expand to your email signature, or use 'rrecycle' to write the Unicode character for the universal recycling symbol. Advanced snippets include operators and placeholders, so you can use a shortcut to enter today's date, or boilerplate text with placeholders you quickly complete in a floating window. The app's performance proved solid and snappy throughout testing, boosting productivity, which this release aims to boost with suggestions. It monitors your input and notifies when you could have saved time by using a shortcut; it also suggests new snippets. The former is great, but the latter too often recommends very short, commonly-used phrases, which we didn't find that helpful.

Craig Grannell

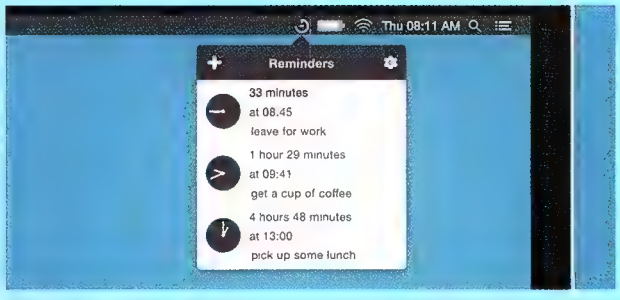


Gestimer

$3.79 | MADDIN.IO

If you thought reminders were sown up by Apple's own app and the likes of Wunderlist, then this menu bar app for Yosemite will make you think again. Gestimer says it's for those 'little reminders', which is something we scoffed at, but after just a few days you'll begin to see the truth in it, and how Gestimer can work alongside your existing reminder apps, rather than replacing them. To set a new reminder, you click and hold on the app's menu bar icon and then drag it down to the centre of the desktop. As you drag, the time for that reminder increases. Let go and you can enter your reminder text and click 'add a description' to set it. Gestimer is perfect for quick reminders when you're in the middle of something because its dialog boxes are unobtrusive. We found ourselves using it for things we wouldn't normally bother adding to Reminders. You really won't bother jotting down last-minute things on paper now!

Christian Hall



Photoshop Mix

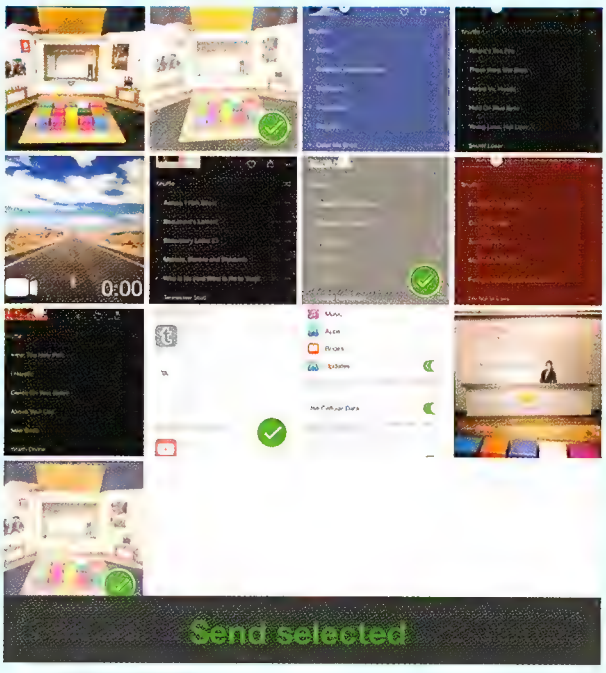
Adobe is mixing things up a bit on iOS (and Android) tablets.

FREE | TINYURL.COM/NT7RUHS

Adobe's latest app for tablets is a slick, touch-based tool for compositing simple double-layer images in a way that's very reminiscent of what the full version of Photoshop offers.

Admittedly short on features, Photoshop Mix is nevertheless a responsive and attractive package that could do with some fine-tuning. Dropping in and out of its various tools can feel a little confusing, and we'd appreciate some additional refinement functionality, but for the most part, Photoshop Mix does a decent job of guiding you through its various areas. The integration of Creative Cloud tools allows you to save your compositions as Photoshop .psd files on your Camera Roll, so you can pull them back and keep on working on them. You can also apply various Looks and Enhancements to your images, though don't expect Photoshop Mix to be a retouching tool – for that, we recommend the previously released Photoshop Touch app. Free and straightforward, Photoshop Mix makes for a fine addition to your stable of Adobe apps.

Stephen Lambrechts

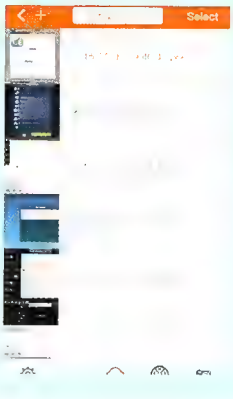


BitTorrent Shoot

FREE WITH IAP | TINYURL.COM/NUY4LUK

Eager to get away from its reputation as a piracy tool, BitTorrent has gotten into the habit of releasing apps that show a number of positive uses for its P2P protocol. First its storage solution BitTorrent Sync, then its completely private messenger app BitTorrent Bleep, and now comes BitTorrent Shoot, an app that uses P2P technology to send and receive large photo and video batches to your friends super fast. Simply enter Select mode to start picking the files you want to send, then hit 'Send Selected' to produce a QR code. Your friend (who must also have the BitTorrent Shoot app installed) can then scan the code, transferring the files directly onto their Camera Roll. The app lets you receive an unlimited amount of transfers for free, though an in-app purchase of $2.49 if you want to send your friends stuff after your third batch. BitTorrent Shoot is a fast and easy-to-use app that makes sending multiple files to another device an absolute breeze.

Stephen Lambrechts



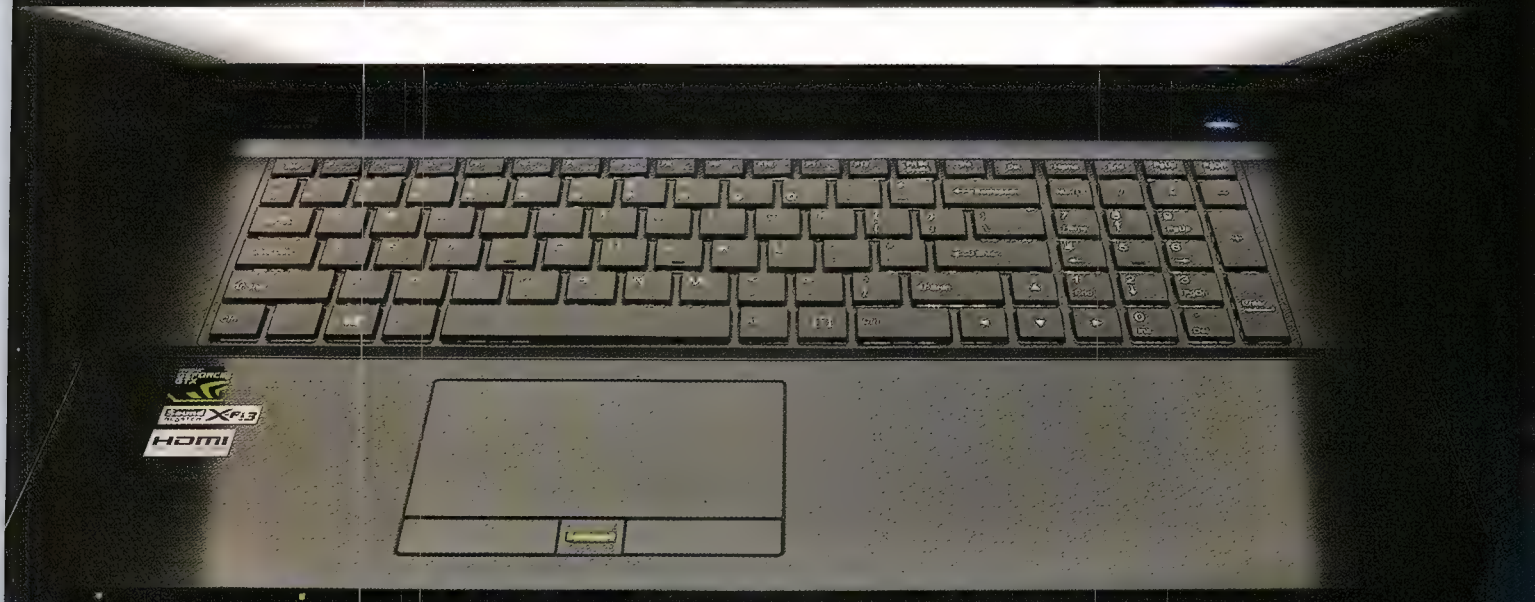
YoVivo!

FREE | YOVIVO.CO

With so many cloud storage solutions available, it's highly likely that you have your documents, images and videos spread out all over the place, making it very difficult to track down a specific file. Wouldn't it be wonderful to have access to all of your clouds in the one place? That's exactly what YoVivo! does. Once you've given it access to your Camera Roll, social networks (including Facebook, Twitter, Flickr, Tumblr, Instagram and more) and cloud storage accounts (Dropbox, Google Drive, OneDrive and more are supported), your files will be accessible from within the app, so you won't have to go on a scavenger hunt every time you need to find something. Its user-friendly interface lists all of your services together for easy browsing. There's even an easy-to-use slideshow creator that lets you drop in images, videos, music and text from any of the files you've linked to the app, with further editing options like filters and emoji livening things up further. YoVivo! is useful and fun. **Stephen Lambrechts**

VENOM

BLACKBOOK 17



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Google Now Launcher

Make your phone Pure Android.

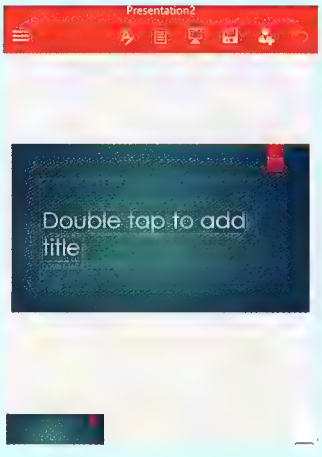
FREE | TINYURL.COM/Q75C244

Most phone manufacturers place their own software 'skins' over each Android handset they release, often changing the OS experience (most notably the launcher) for the worse. Thankfully, Google Now Launcher is here to purify your Android phone.

Possibly the most exciting app that Google has released in a while, Google Now Launcher brings a Nexus-style purity to your phone, providing it with a stock Android launcher. You can now enjoy an experience that's previously only been available on the Nexus 5, so long as your device is running Android 4.x or above. The Google Now Launcher also makes Google's personal assistant a core part of your phone. It's a Google service that offers personalised information 'cards' that you can reach by swiping left on your home screen, in order to choose what you want to receive notifications about. It also provides always-on voice capability, which you can reach by saying "OK Google", and then asking it a question. **Stephen Lambrechts**

Microsoft Office

FREE WITH MICROSOFT ACCOUNT; OFFICE 365 SUBSCRIPTION UNLOCKS MORE FEATURES | PRODUCTS.OFFICE.COM

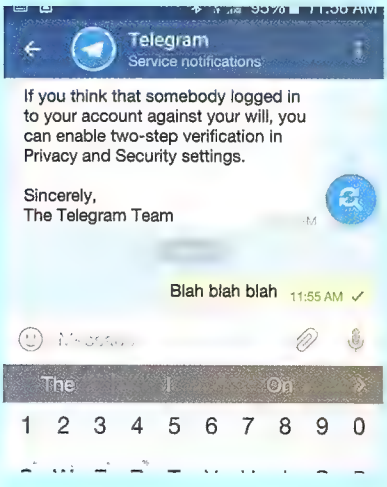


For many workers, Microsoft's Word, Excel and PowerPoint apps have been the cornerstone of modern productivity for over two decades, but until June of this year, Microsoft had held off releasing its official Office products for Android phone users. Fortunately, that's no longer the case and, on the proviso you're willing to set up a free Microsoft account, you can now use your Android phone or tablet to edit and view documents to your heart's content. That Microsoft account really is the key to the kingdom here, because if you don't have one — or you'd prefer not to set one up — then you'll only be able to read Office files. Once you're in though, the Office apps are clean and well-designed, allowing you to do all the basics you'd expect (and more than most users probably need). That includes opening and saving documents through your OneDrive account, or even syncing the apps with Google Drive and Dropbox. As far as Android productivity apps go, Office is pretty great, but considering how well-established apps like Google Drive already are on this platform, it might not be enough to convert the masses. **Joel Burgess**

Inputting+

FREE WITH IAP | TINYURL.COM/OU4AC7A

Ever wanted to have undo, redo, clipboard or 'find and replace' functionality for text when using your smartphone? That's exactly what Inputting+ provides. Once enabled, the app places a bubble on your screen whenever text input is available (don't worry, you can make the bubble small and transparent) that lets you undo what you've just written with a single tap, and redo it with a second. Unlocking the Pro version of Inputting+ (for a ~$1.35 fee) will provide you with a timeline of collected text inputs from every app, so you won't lose anything you've written due to a crash or poor reception. If you've ever had that happen to you, enabling Inputting+ should be a no-brainer. While you do have to give the app access to monitor your text inputs, it doesn't have web permissions, so your texts won't be collected and read by anyone online. If you're cool with this, you'll find Inputting+ to be a very useful addition to your Android arsenal. **Stephen Lambrechts**


Telegram
Service notifications
If you think that somebody logged in to your account against your will, you can enable two-step verification in Privacy and Security settings.
Sincerely,
The Telegram Team
Blah blah blah 11:55 AM
1 2 3 4 5 6 7 8 9 0

Stick Cricket Premier League

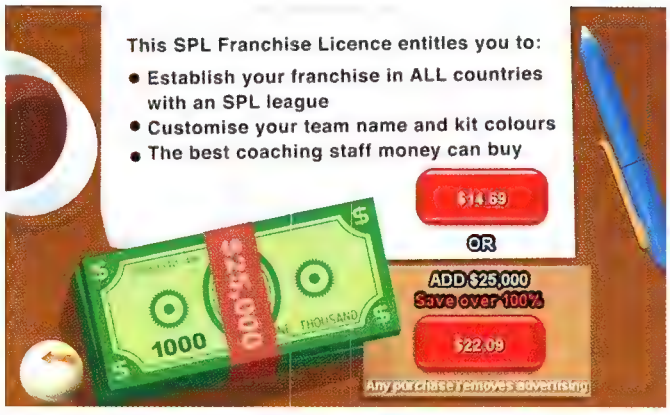
Howzat!!!

FREE WITH IAP | STICKSPORTS.COM

Even if you're not into cricket, chances are you've been out to bat in one of the many variations of *Stick Cricket* since the first web browser version came out in 2006.

Though it's been available on Android and iOS for a while, Microsoft is pushing it as a drawcard launching on the Windows 10 for Mobile platform. The game's actually compatible with Windows Phone 8.1 and up, so there's no need to wait for the new smartphone OS to launch here.

Stick Cricket Premier League might trick you into thinking that this game is simple — the only controls are a left and right shot — but the bowlers get progressively slower and somehow that actually makes hitting the ball exceptionally hard. The base app is free, but in order to build your own team with decent players you're going to have to fork out for some in-app purchases, of which there are many — something to be cautious of if kids are playing. Other than that, it's a worthwhile app for Windows Phone. **Joel Burgess**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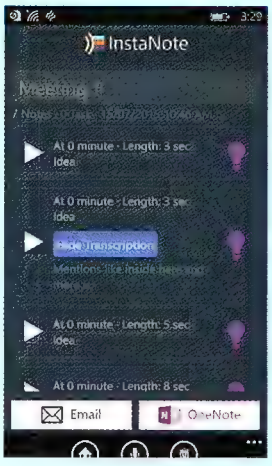
Microsoft InstaNote

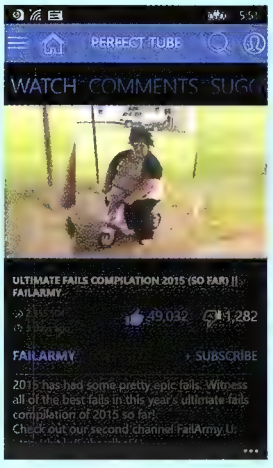
FREE | MICROSOFT.COM/GARAGE



One thing about having an operating system created by Microsoft is that there never seems to be a shortage of note-taking apps. Despite the plethora of options already available to Windows Phone owners, chances are you'll likely still want to take a look at this new offering from Microsoft's edgy DIY innovation centre: Microsoft Garage. Yes, on top of note-taking, InstaNote also has an audio recording feature, although this app's audio capture method is a little different to most. Instead of the usual start-and-stop recording, this app has a button that will capture the last 30 seconds of audio and run it through Bing, where all that audio will be transcribed into a succinct set of notes. The idea of having the most important chunks of a lecture, meeting or interview transcribed for you sounds like a dream come true, but admittedly, InstaNote is a little tricky to use at first and it doesn't always flawlessly transcribe notes. That said, in the worst-case scenario, you still have all the audio snippets of the most important info. **Joel Burgess**

Perfect Tube

FREE | PERFECTTHUMB.COM

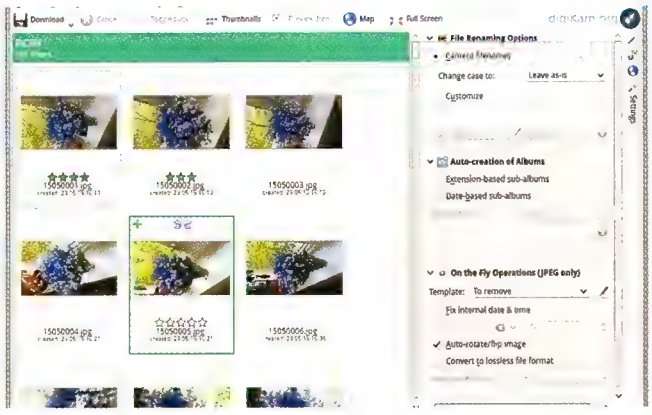


There are plenty of YouTube clients on the Windows Phone platform, including a YouTube app published by Microsoft itself, so the fact that Perfect Tube is worth a mention speaks for itself in a way. It's clear that this third-party YouTube app, developed by Perfect Thumb, was built from the ground up for the Windows Phone platform. The video player has a full set of large controls that are intuitive and discrete. Changing the volume or skipping through a video is navigated by swiping up/down or left/right, respectively, making the controls a lot less fiddly than finding little icons or dragging a miniature toggle. However, it isn't just the controls that are useful — the app also facilitates the full range of video interactions if you sign in, and the home page features your subscriptions page and a 'popular local clips' section. Unfortunately, you can't comment on videos, which may turn some users away, but if you can live without that social element, Perfect Tube is a great YouTube app for Windows Phone. **Joel Burgess**

digiKam

Powerful and free photo management for Linux.

FREE | WWW.DIGIKAM.ORG



Most of us shoot photographs and store them on a hard drive of some kind, whether that's just our smartphone snaps or more sophisticated RAW files from a DSLR camera. Since it doesn't take long for the amount of photos to get out of hand, most of us need a way to store, sort and organise them. In the world of Linux photo managers, digiKam is the most advanced and solid application for this job.

This splendid and heavyweight open-source application shows very robust development speed, delivering good news every few months. The 4.x series is constantly updated with maintenance releases, bringing scrupulous bug fixes as well as better multi-monitor support, improved geotagging, face recognition, colour management, extra key strokes and lots of many minor goodies.

In digiKam, photos can be organised into albums, which can be sorted chronologically, by directory layout or by custom collections. Each photo can be assigned with one or many tags, so you can view and browse tagged images all at once, despite the photos being spread out across multiple directories. Besides tags, custom comments and star ratings can be added to each photo and altered in future. All this is stored in a robust and reliable SQLite database.

digiKam makes use of KIPI (KDE Image Plugin Interface) plug-ins for lots of added functionality and shares some image effect plug-ins with other KDE-related applications, such as Gwenview and Krita. There are tons of features in digiKam and the most prominent ones are its gorgeous photo-importing dialog; its automatic facial recognition and sorting; its powerful editor for playing with colours and exposure; batch queue manager; and light table for comparing similar shots. digiKam also features Marble integration for showing maps and a very useful fuzzy search tool for coping with 'nearly identical' shots.

digiKam is included with almost any distro, so the only question left is where to get the latest release. Users of Ubuntu and Mint can get it from dedicated ppa (ppa:philip5/extra), while Arch/Manjaro users can always turn to AUR.

Alexander Tolstoy

Nemo

FREE | GITHUB.COM/LINUXMINT/NEMO

Some people think of Nemo as a submarine captain, others as a ridiculously cute clownfish that's lost, while every Linux Mint user knows that it's actually a file manager. Nemo 2.6 was released recently together with the whole Cinnamon 2.6 desktop environment; however, it can also be used as a standalone file manager in any desktop of virtually any distro.

Nemo history starts in 2012 when developers behind Linux Mint forked the Nautilus 3.6 file manager in order to save it from a Gnome's attempts at simplifying everything. Since then, Nemo has become recognised as a GTK3-based file manager that supports desktop icons mode, compact view, full navigation options and lots of great configuration options — a lot more than can be found in Nautilus.

The most notable feature of Nemo 2.6 is a plug-in manager, which allows the enabling and disabling of Nemo actions, extensions and scripts with a few clicks. The plug-in manager is available as the Plugins entry in the Nemo's menu. Once the manager is launched, it shows the list of available actions, extensions and scripts with a checkbox in front of each.

Linux Mint also runs a separate project (**github.com/linuxmint/nemo-extensions**) to port the available Nautilus extensions to Nemo, such as file name repairer, image converter, sharing extensions and some others. Besides new plug-ins, Nemo enables bookmark sorting, toggling of the location bar to a path-bar and putting file operations in a queue (this is the default behaviour in 2.6). Thanks to this, the file manager combines the simplicity and elegance of Gnome-styled applications with a feature set very close to Dolphin.

The Nemo file manager comes with Linux Mint by default, but there's also a separate PPA for Ubuntu where you can install Nemo without Cinnamon dependencies (ppa:webupd8team/nemo). Outside of that the availability of Nemo is quite limited: it's offered for Fedora, OpenSUSE and Arch/Manjaro, while you'll find that the lesser-known distros are left out in the cold.

Alexander Tolstoy

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MASSIVE COMPARISON

GET YOUR STORAGE SORTED

FROM SUPERFAST SSDs TO BEHEMOTH NETWORK BOXES: THE EXPERT GUIDE TO STORING MORE STUFF

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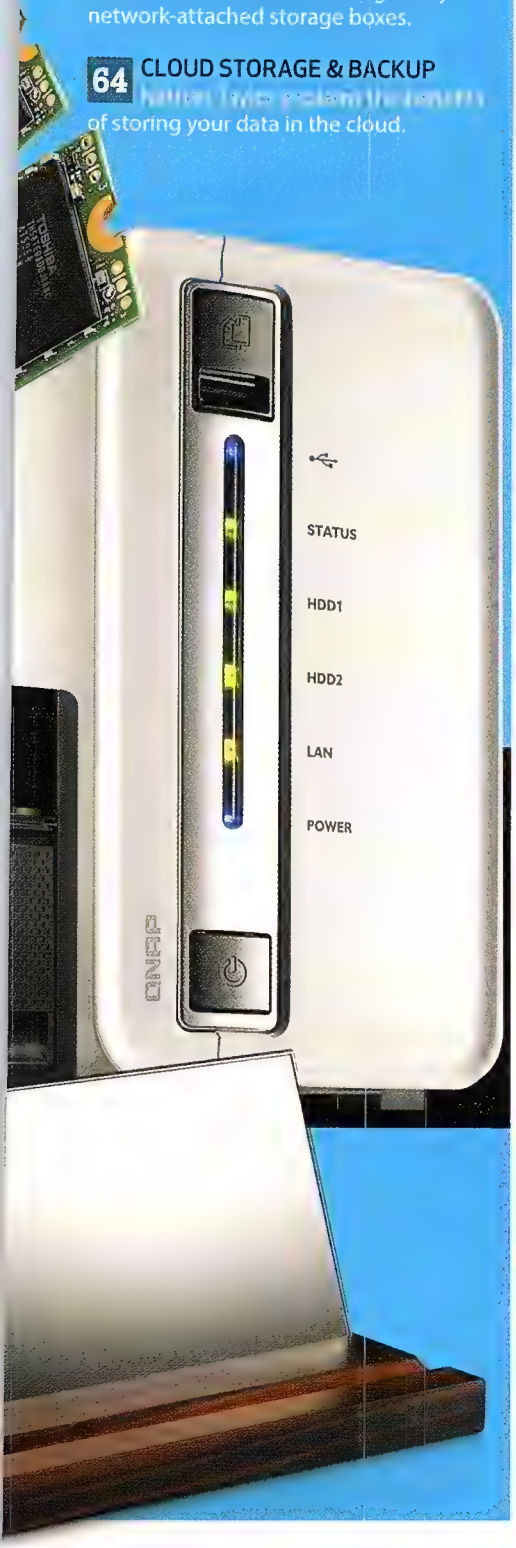
64 CLOUD STORAGE & BACKUP
[illegible] of storing your data in the cloud.



UNTANGLING THE STORAGE WEB

Digital storage is a more diverse area than ever, so to accompany this month's superguide, we've put together a short and sharp guide on which options to use where in your storage matrix.

SOLID-STATE DRIVES

With their higher cost per gigabyte, SSDs are internal storage disks that are best used in high-demand situations: as your OS drive and where you install your games and other applications. If you have multiple SSDs, use your fastest one for your OS; additional units can be used as secondary drives for apps and games. SSDs come in multiple types: there are models that connect to the Serial ATA (SATA) interface and look much like 2.5-inch internal hard drives, but there are also newer types that connect directly to a desktop computer's PCI-Express (PCIe) slot, or plug into the newer M.2 socket in a similar fashion to RAM. You'll need to carefully check what connectivity options your PC has before buying one.

INTERNAL HARD DRIVES (MECHANICAL)

The most common form of storage for desktop and laptop PCs, mechanical SATA drives come on two main physical forms (known as 2.5-inch and 3.5-inch) and these are best used for general storage: for media files and other large space-consuming content. Of course, they're also perfectly serviceable if you want to run your OS, apps and games from them – but doing so will result in a less responsive experience than on an SSD.

EXTERNAL HARD DRIVES (MECHANICAL)

External hard drives take two main forms (portable and desktop) and are often just internal hard drives wrapped in a USB enclosure. Most commonly, they use the USB 3.0 interface, with the odd unit offering Thunderbolt or FireWire connectivity. They're good for moving around very large files, performing system backups (if you don't have a NAS) and you can even work on files directly from them if your PC doesn't have much onboard storage, though doing so will generally be slower and less responsive than on an internal drive.

WIRELESS HARD DRIVES

This newer category typically combines a portable external hard drive with a built-in Wi-Fi hotspot and battery, meaning you can take it on the road with you and connect directly with a laptop, or via dedicated apps for iOS and Android smartphones and tablets. In the latter two cases, the app is often what defines exactly what you can and can't do on your mobile device – that can range from syncing your photos to streaming music and movies from the device.

NAS BOXES

A network-attached storage (NAS) device is something we reckon every home and small office should have: it creates a convenient and affordable central storage location for sharing and backup. Accessed through your network (either wired or wireless), today's NAS boxes can actually do far more than just store files – they can download from the net (and even BitTorrent), stream media files to your TV or games console, and some will even let you run your own cloud services, like remote photo backup or document editing. These are incredibly flexible and powerful options, perfect for multi-user environments.

CLOUD STORAGE

Online (aka cloud-based) storage is great for quickly sharing small files, allowing anywhere access to critical content and backing up your photos on the go. Most services offer a small to medium allotment of free gigabytes (anywhere from 2GB to 100GB), then options to pay a subscription fee to add more. The limited upload speed of most Aussie broadband connections means that cloud storage is less flexible than local options (uploading multi-gigabyte files through a 1Mbps ADSL uplink can take days, for example), so you do need to approach how you use it with that limitation in mind.

SSDs level up

Forget SATA for SSDs – there's a new breed of solid-state storage that blasts through old bottlenecks thanks to PCIe. Lindsay Handmer tests eight examples.

As computer hardware becomes more powerful, access to data has become a problematic bottleneck that solid-state drives (SSDs) have helped open up. SSDs have now hit something of a speed limit themselves, however, because most of the PC's existing storage interfaces were originally designed for older mechanical hard drives and are already too slow for SSDs. The majority of mainstream drives can already max out the SATA 6Gbps interface, and even the newer upgraded SATA Express is too slow for some.

PCI-Express (PCIe) is the answer, with an x16 slot able to provide up to 32GB/s of bandwidth and thus giving plenty of scope for performance growth. It's only been recently that fast PCIe SSDs have been available to general consumers, but even these have faced issues with cost and performance. In the last year or so, the M.2 interface has helped small form-factor SSDs drop in price and has become a popular option for both desktops and laptops.

M.2 drives can use the SATA interface, but when doing so are limited in bandwidth like any SATA SSD. On compatible motherboards, however, M.2 can also plug into the PCIe interface directly, letting SSDs run to their full speed potential without any bandwidth bottlenecking. For desktops without an M.2 socket, these drives can be plugged into a PCIe slot adaptor board, and there's also a smattering of dedicated PCIe card-based SSDs on the market. Even within PCIe SSDs, there are a variety of speeds available, depending on which controllers, NAND and PCIe interface is used.

Of course, being new, these next-gen SSDs have a tendency to be more expensive than their more common SATA brethren – usually at least double the cost per gigabyte. But then, with most PCIe SSDs more than doubling the performance of their SATA counterparts, they're arguably also worth the higher prices.

"With most PCIe SSDs more than doubling the performance of their SATA counterparts, they're worth the higher prices."

LABS TEST RESULTS

		ASX SSD			CRYSTALDISKMARK	
	PRICE PER GB	SEQUENTIAL READ/ WRITE (MB/S)	4K READ/WRITE (MB/S)	PROGAM COPY SPEED (MB/S)	SEQUENTIAL READ/ WRITE (MB/S)	4K RANDOM READ/ WRITE (MB/S)
APACER THUNDERBIRD PT910 256GB	$1.95	698.25/542.75	23.22/81.47	301.83	701.2/522.1	24.58/91.46
G.SKILL PHEONIX BLADE 480GB	$2.08	1,825.12/989.65	25.78/91.25	373.21	1,389.4/931.7	33.25/110.4
INTEL 750 SERIES 1.2TB	$1.12	2,276.65/1,285.18	34.79/202.89	556.31	1,528/1,298	34.31/250.2
KINGSTON HYPERX PREDATOR 480GB	$1.35	11,63.62/943.65	31.37/101.46	385.37	1,287/1,011	31.33/109.2
OCZ REVODRIVE 350 480GB	$2.50	1,703.60/938.17	24.68/92.40	366.7	1,292/850.3	35.14/106.3
PLEXTOR M6E 128GB	$1.41	677.59/311.15	21.74/79.32	255.32	659.8/329.6	21.77/81.88
PLEXTOR M6E BLACK EDITION 256GB	$1.36	637.19/556.90	20.01/76 68	270.48	681.7/566.8	23.88/82.25
SAMSUNG XP941 512GB	$1.25	1,075.72/875.66	29.44/102.12	338.13	953.5/873.6	33.41/133.4

PCIE SSD

$499 | WWW.APACER.COM

Apacer Thunderbird PT910

An all-in-one PCIe RAID solution.

Even as drive manufacturers are releasing PCIe SSDs in both M.2 and slot form factors, some are sticking to well-worn tech. The Thunderbird PT910 couples SATA SSDs into a half-height PCIe card – no native PCIe or M.2 capabilities are included. Instead, the Thunderbird uses a Marvell 88SS9220 controller to couple two 128GB chunks of Intel MLC NAND (running SandForce SF-2241 controllers) to a PCIe interface. The result is a PCIe SSD that runs RAID 0 internally – no user setup required. Unlike almost all the other SSDs on the market, the PT910 actually becomes more expensive per gigabyte if you opt for the $1,149 512GB model.

Because the PT910 only uses a x3 PCIe 2.0 connection, throughput is limited to a maximum of 1,000MB/s. The result is speeds that easily best standard SATA SSDs, but fall short of the faster PCIe offerings. With sequential read/write speeds of 701/522MB/s, respectively, the PT910 has similar performance to the Plextor SSDs, which also use a PCIe 2.0 x2 interface. When it comes to 4K random data, the Apacer SSD's RAID setup is a little better, especially with a higher queue depth. The Thunderbird is rated at 100,000 read/write IOPS, and managed a 24/91MB/s read write speed with 4K random data.

The result is an SSD that isn't quite fast enough or cheap enough to effectively compete with the rest of the competition. Keep your eyes peeled, though – Apacer has promised some new M.2 PCIe later this year.

Verdict

Faster than a SATA SSD, but outclassed by the native PCIe drives.

★★★☆☆

PCIE SSD

$999 | WWW.GSKILL.COM

G.Skill Phoenix Blade

How much are you willing to pay for performance?

Available in 480GB (as tested) or 960GB flavours, the Phoenix Blade was launched late last year to bring high-end performance to your PCIe slot. The half-height drive doesn't use M.2 at all, so it's relegated to desktop use. Like the OCZ RevoDrive, the Blade uses a PCIe to SATA controller, essentially running four SSDs in RAID 0 on the board. Each of the four 128GB banks use Toshiba MLC NAND coupled to a SandForce SF-2281 controller. The whole kit and caboodle is covered by an aluminium heatsink to keep the components cool while handling your data. The result is a sleek PCIe 2.0 x8 SSD that offers high-end speed, albeit with a hefty $999 price tag.

In testing the Phoenix Blade offered excellent sequential read and write speeds of 1,825/989MB/s, besting the more expensive RevoDrive. Still, the G.Skill is still slower and more expensive per gigabyte than the more advanced Intel PCIe setup. Random 4K read and writes are worse than the better competing M.2 PCIe drives, at 25/91MB/s, respectively. The Blade is rated for 90,000/245,000 read write IOPS, which is quite good.

The Phoenix is rated for a massive 1.4TB of data written per day over the three-year warranty period. This figure is actually very important because for those who need to write a lot of data, the Blade is a clear winner. You can also pick up the G.Skill SSD in a 960GB version for $1,649.

Verdict

Fast but overly expensive unless you need the excellent endurance.

★★★½☆

$1,349 | WWW.INTEL.COM.AU

Intel SSD 750 Series 1.2TB

For those who want the best of the best... and can afford to pay for it.

Unlike the other drives we tested, the Intel 750 uses NVMe (non-volatile memory express) rather than AHCI (adaptive host controller interface). The new interface is the way of the future and will let SSDs continue to push performance as the technologies evolve. The 750 isn't some M.2 SSD strapped into an adaptor either – it's a half-height PCIe slot only drive that uses x4 Gen 3.0 lanes. The Intel 750 comes in two different capacities: 400GB or 1.2TB, as tested. The SSD in our Labs uses Intel 20nm MLC NAND, with 4GB of cache RAM and an Intel CH29AE41AB0 controller buried under a large heatsink.

Not surprisingly, it's fast. Crazily fast. We managed 2,276/1,285MB/s sequential read and write speeds – way in excess of any other SSD tested. 4K read and write tests stand out too, at 34/250MB/s, respectively. For random access, the drive is spec'd at 440,000/290,000 IOPS, reading and writing. While the sequential read speed is great, these numbers show that the 750 also excels at high queue depths. The 400GB model is a little slower (especially on writes), but it's not a huge gap. Intel backs the SSD with a five-year warranty, and rates it at 70GB of data written a day.

At $1,349, the Intel 750 is an expensive SSD, but actually gives the best cost per gigabyte, though the $549 400GB version isn't as good. Still, if you want high-end performance then there is currently no better option available.

Verdict

Insanely good performance for a better-than-expected price.

★★★★½

$649 | WWW.KINGSTON.COM

Kingston HyperX Predator

The latest high-performance SSD from a well-known name.

Rather than being an all-in-one PCIe card unit, the Predator is simply a standard 2280 PCIe M.2 SSD plugged into a half-height adaptor card. You can get it in both 240GB and 480GB options, and the actual M.2 SSD itself can be simply unscrewed and removed if desired. It's also possible to buy the M.2 drive itself without the adaptor, but prices are about the same, so there's not much point. The SSD uses the 2820 M.2 form factor, measuring in at 80mm long and 22mm wide.

The HyperX uses the second-generation Marvell 88SS9293 controller, 1GB of DDR3 cache and Toshiba A19 NAND feeding back through a PCIe 2.0 x4 interface. Performance is excellent, with fast 1,287/1,011MB/s read and write speeds. Compared to older PCIe SSDs that only just outpaced SATA 6Gbps, this is a very noticeable step up in performance. 4K random read and write speeds are also excellent, at 31/109MB/s, respectively.

The 480GB model is rated at 882TB over the three-year warranty, or a massive 800GB per day. The Predator SSD is bootable too, but is quite a power-hungry drive, so it's best suited to desktop rather than laptop use.

The 240GB model costs $339, while the 480GB will set you back $649. While it's not the cheapest PCIe M.2 SSD on the market, the fast speeds mean the HyperX still offers strong bang for buck.

Verdict

High-end performance aimed at those willing to pay the premium.

★★★★½

PCIE SSD

$1,199 | WWW.OCZ.COM

OCZ RevoDrive 350

Can this older tech drive take on the newcomers?

Launched last year, the 480GB OCZ RevoDrive 350 takes full advantage of your PCIe slot for high-end AHCI performance. Inside the SSD is a collection of Toshiba 19nm MLC NAND chips and four SandForce SF-2282 controllers. Internally it's arranged as a SATA 6bps RAID array coupled up to a PCIe x8 interface. On the outside you get a sleek aluminium heat spreader to help keep the drive cool.

What all this means in the real world is an impressive 1,700MB/s read speed, backed up by 900MB/s writes. If you write a lot of the data, the 50GB a day endurance over three years is decent, but not outstanding. It's also good for 140,000 IOPS and 90,000 IOPS writing and reading, respectively.

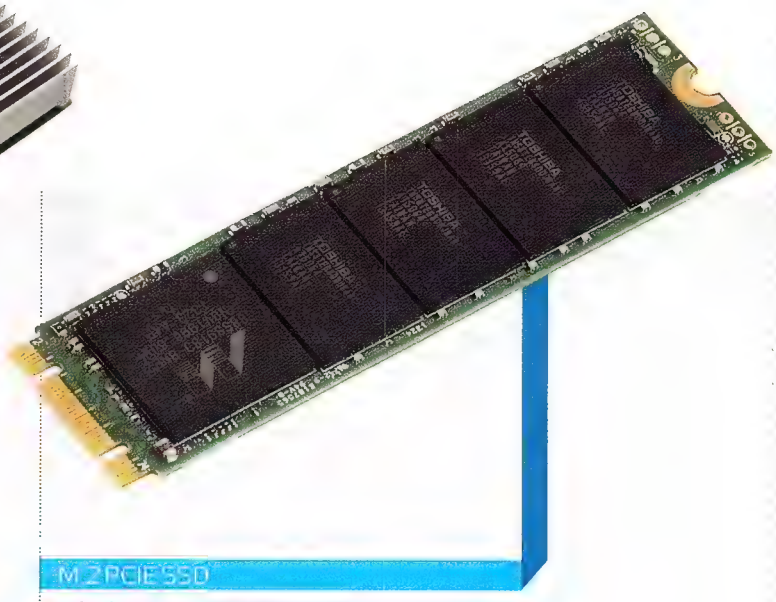
It's worth noting that the RevoDrive is full-height (though half-length) PCIe card. It's also slightly power-hungry at idle, drawing 9.5W. It's also AES-128 compliant, for those who want to encrypt their data.

The problem with the RevoDrive is the price – an eye-watering $1,200 for 480GB. While few other drives are as fast, there are still better options for less money. If you want a smaller drive, the 350 also comes in a 240GB flavour, though it will set you back a hefty $600 and is significantly slower. Jumping up to the 960GB version is the other option, but it doesn't get any cheaper per gigabyte and you'll need to pony up a massive $1,800.

Verdict

Fast, but expensive, especially for the large sizes.

★★★☆☆



M.2 PCIE SSD

$180 | WWW.GOPLEXTOR.COM

Plextor M6e

A no-frills M.2 2280 option.

Using the PCIe 2.0 x2 interface, rather than SATA 6Gbps, the Plextor SSD comes in 128GB (as tested), 256GB and 512GB models. It uses the standard M.2 2280 form factor, measuring in at 80mm long, 22mm wide, 3.8mm thick and weighing 13g. The drive doesn't include any accessories – you'll need a compatible PCIe M.2 slot or PCIe adaptor card to use it. The Plextor M6e SSD uses the Marvell 88SS9183 controller to drive Toshiba 19nm MLC NAND and has a 256MB DDR3 DRAM cache.

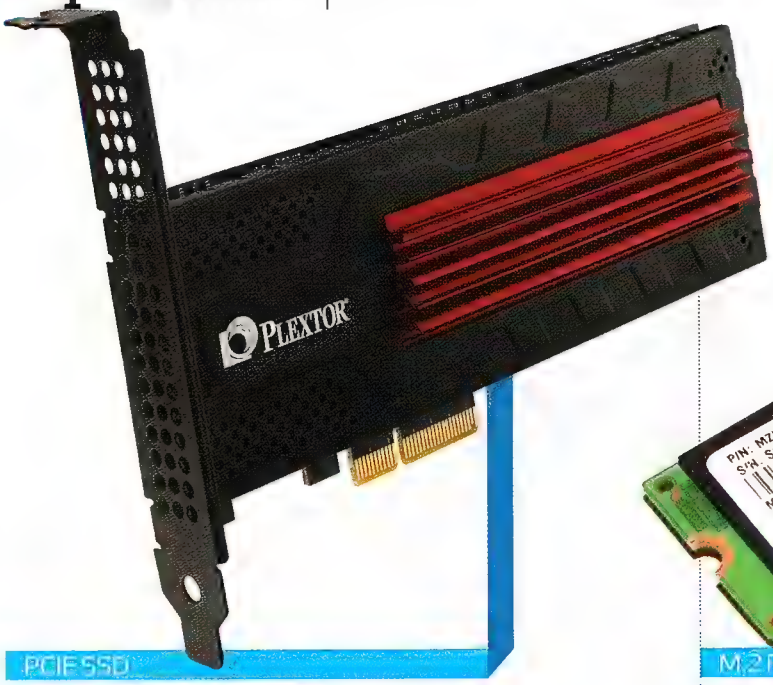
Performance is faster than what the limited SATA 6Gbps interface can handle, with sequential reads hitting 659MB/s. Write speeds are limited in the 128GB model and only manages 329MB/s – the larger-capacity drives should hit 500MB/s plus. The M6e performed well at random 4K reads and writes and on par with the Plextor Black Edition SSD. The 128GB M.2 is rated for 96,000/83,000 read/write IOPS. Plextor doesn't provide an endurance rating for the drive, though the company does back it with a five-year warranty.

The SSD comes with a suite of software, such as PlexTurbo, which can use some of your system RAM as an SSD cache to further boost performance as well as increase lifespan. The M6e supports 256-bit AES encryption and can run as a boot device.

Verdict

A painful price premium gives faster than SATA 6Gbps performance.

★★★☆☆



PCIE SSD

$349 | WWW.GOPLEXTOR.COM

Plextor M6e Black Edition

Besting the SATA 6Gbps competition.

Hidden under a sleek black cover, with standout red heatsink, the M6e has a rather standard AHCI PCIe M.2 SSD. With the integrated cooling solution clamped over the drive (and a 'warranty void if removed sticker' adorning the screws) plus an extra SATA power connector, it's more than just a PCIe slot adaptor. But still, if you have a suitable PCIe M.2 slot on your motherboard, the SSD could be plugged in directly. This is handy, as it means you could use the drive without taking up an extra PCIe slot if you upgrade your motherboard.

Our test SSD had a 256GB capacity, made up of Toshiba MLC NAND coupled to a Marvell 88SS9183 controller working through a PCIe x2 interface. Sequential read and write speeds of 637MB/s and 556MB/s are a cut above SATA SSDs, but not by a huge margin. It's worth noting that the lower-capacity SSDs have slower write speeds, while the larger ones tend to give a performance boost.

The Plextor SSD comes with a Turbo software tool that can use 25% of your system RAM as a drive cache to boost performance. It also supports AES-256 data encryption, but no endurance figure is given.

The smaller 128GB Plextor SSD costs $220, which isn't a particularly good deal over the $349 for the 256GB version we tested. The larger 512GB M6e is hard to find, but offers a slightly better price per gigabyte ratio at $660. All the Plextor drives offer a full five-year warranty.

Verdict

Faster than a SATA SSD, but also quite a lot more expensive.

★★★½☆

M.2 PCIE SSD

$640 | WWW.SAMSUNG.COM.AU

Samsung XP941

High-end M.2 performance.

Despite being last year's model (and originally an OEM drive), the XP941 is still one of the faster PCIe M.2 SSDs available. The drive is sold in 128GB, 256GB and 512GB (as tested) models, and uses the standard 2080 M.2 form factor – no PCIe slot adaptor is included. The XP941 is an AHCI SSD, using four lanes of PCIe 2.0. The drive features Samsung's own 64Gbit 19nm MLC NAND, with the S4LN053X01 controller.

We tested the 512GB model and not surprisingly, performance was excellent. Peak sequential read and write speeds were 1,075/875MB/s – easily outpacing the fast SATA drives as well as some of the PCIe competition. 4K random read and writes were also solid, at 29/102 MB/s, respectively. Samsung rates the drive at 122,000/72,000 IOPS for random 4K read and writes. Performance is degraded on the 256GB and 128GB versions of the SSD, though it's the write speeds that suffer the most. The drive is rated to 400GB of data writes a day, with a three-year warranty.

One boon for laptop users is that the XP941 has a 0.08W low-power idle state that will help your battery last longer. However, check your compatibility, as not all laptops or desktops can boot from the SSD.

The 128GB model is available for around $165, while the 256GB will set you back $320. The 512GB model at $640 offers a gigabyte per dollar ratio comparable to other M.2 SSDs.

Verdict

Still one of the faster PCIe M.2 SSDs available.

★★★★☆

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- Operates with cordless phones
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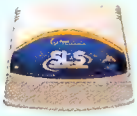
- Optional After Hours Announcement



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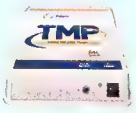

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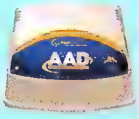

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External storage for any need

There's more to today's external hard drives than just tacking on extra terabytes. Joel Burgess and Paul Taylor investigate.

Physically, external hard drives have continued to shrink over the last decade, and they've almost reached the point where their size is starting to be limited by the constraints of having a mechanical spinning disk. But just because external hard drives aren't significantly reducing in size doesn't mean that the're not developing in other ways.

USB 3.0 is now basically commonplace and the additional power it can deliver (along with faster transfer rates) means that larger, more power-hungry drives can run without needing a dedicated power cord. Testament to this is the new 3TB My Passport Ultra from Western Digital – a pocket-sized portable which offers as much space as entry-level desktop drives. This newfound capacity for portable drives has been eating into the external desktop drive market, making dedicated 'wall powered' drives harder to come by – despite putting an open call out to all the major drive vendors, we only received one of the latter for this feature.

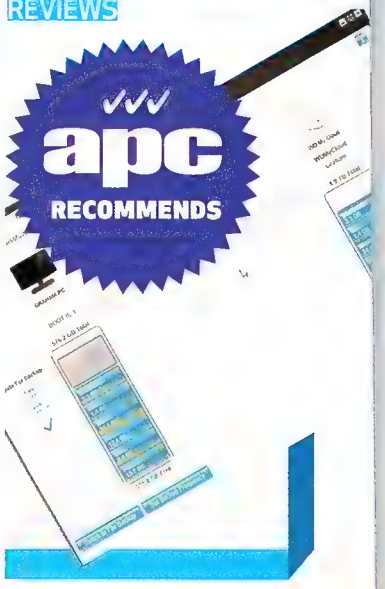
Another complicating factor in the external-storage equation is the emerging wireless hard drive category. These are targeting smartphone and tablet use as much as PCs and laptops. As our mobiles become more important to us and streaming home media technology becomes more attainable, hard drives that can back up data from a range of devices are taking more of the spotlight from plug-bound options.

LABS TEST RESULTS

PRODUCT NAME	SUSTAINED READ SPEED (MB/S)	SUSTAINED WRITE SPEED (MB/S)	SMALL FILES READ SPEED (MB/S)	SMALL FILES WRITE SPEED (MB/S)	COST PER GB	WEIGHT (G)
LACIE MIRROR (1TB)	108.7	107.6	41.19	24.37	$0.399	230
SEAGATE BACKUP PLUS FAST (4TB)	250.4	249.5	42.78	88.85	$0.097	307
SEAGATE SEVEN (500GB)	120.9	118.9	41.35	37.33	$0.340	178
SEAGATE WIRELESS (500GB)	42.73	40	24.21	37.36	$0.290	270
SILICON POWER ARMOR A65 (1TB)	119.9	119.8	39.99	47.26	$0.110	258
TOSHIBA CANIVO AERO CAST (1TB)	117.8	116.7	42.81	50.28	$0.269	280
TOSHIBA CANVIO BASICS (2TB)	116.4	114.2	42.21	47.27	$0.075	210
TOSHIBA CANVIO SLIM II (1TB)	111.8	111	42	48.52	$0.120	150
WD MY BOOK DUO (12TB)	331.7	184.2	53.68	34.22	$0.075	2,300
WD MY PASSPORT PRO (2TB)*	206	210	N/A	N/A	$0.200	450
WD MY PASSPORT ULTRA (1TB)	113.9	112.8	44.07	62.24	$0.093	150
WD MY PASSPORT X (2TB)	116.4	116.2	43.58	59.46	$0.100	238

*TESTED ON MAC WITH BLACKMAGIC DISK SPEED TEST

BUNDLED SOFTWARE REVIEWS



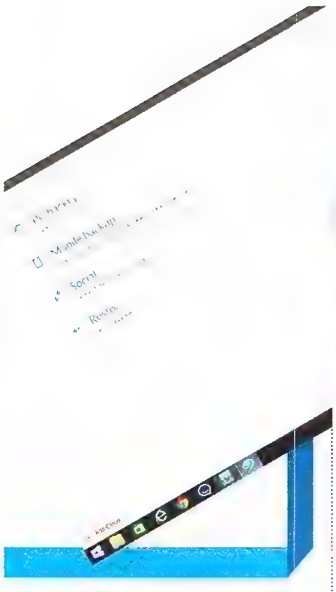
WD SmartWare, Drive Utilities & WD Security

Apple computers already come with system backup software (Time Machine), but for Windows users Western Digital drives include a backup suite called SmartWare that can help fill the gap. SmartWare is reasonably standard, providing options for scheduled backups, specific retrieval processes and software updates. WD drives also come two other apps: WD Drive Utilities and WD Security. The Security program will encrypt your drive so it can only be unlocked using a specific password – and you'll have to completely reformat it if you happen to lose or forget the password. Drive Utilities lets you diagnose any problems with the drive, manage the RAID configuration (on applicable models), set a sleep timer and reformat the drive for optimal performance on the device you intend to use it with. As a whole, these three apps give you an extremely effective toolkit for tackling basic external-storage tasks.

Verdict

A functional set of external hard drive applications that do the basics well.

★★★★



Seagate Dashboard

Unlike WD's 'three-pack' software approach, Seagate's bundled all its up into one app called Seagate Dashboard. Dashboard initially pushes you towards a specific backup schedule, so that once you have configured it, you won't have to think about it again. While that should suit the majority of users, it does mean you sacrifice some versatility, as Dashboard makes it more difficult to actually change the backup structure later. Though it's easy enough to manually reformat an external hard drive through OS tools, it's worth noting that Dashboard doesn't include a built-in formatting features. You can also use Dashboard to schedule backups from your desktop or smartphone using third party cloud services such as Dropbox, Google Drive and OneDrive.

Verdict

A streamlined backup suite that could do with a few extra features.

★★★½☆

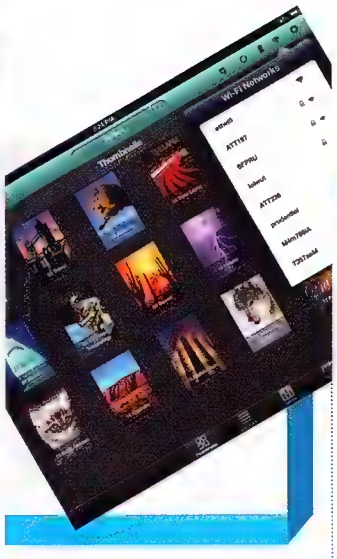
Toshiba software suite

Toshiba's Basics range of drives don't actually come with any software, but if you step up to the higher-end models then there's a decent selection of third party apps. The included NTI Backup Now EZ software nicely takes care of the automated backup tasks and basic interactions with your PC, and you also get PogoPlug to access the drive from your Android or iOS device. Set this up on your PC and leave your drive connected and you can access all your files remotely through the smartphone app or even a browser, which is a handy little bonus feature. A HDD Password Tool means you can fully encrypt the drive with a password. If software is a deal-maker for you, then this comprehensive package available with some Toshiba drives may just take the cake.

Verdict

The best overall software package, but only available on select Toshiba drives.

★★★★½



Seagate Wireless apps

The Seagate Media app is a little different. Made for use with the Seagate Wireless external hard drive, it lets the latter act more like a media server. The app's available on Android and iOS devices as well as Windows and Mac desktop OSs and when using it, you access the drive over Wi-Fi. The app interface is split into four folders (music, photos, videos and documents) that mirror what's on the drive and the app lets you view all to these various media files – and you can also upload and download these files over Wi-Fi. In comparison to external hard drive speeds, moving stuff over Wi-Fi is frustratingly slow, so we'd recommend connecting the drive through USB for bigger file transfers. For streaming media, the app works reasonably well and it can even stream to selected LG smart TVs, Chromecasts and Rokus.

Verdict

Wireless apps still have some way to come and this one is no exception.

★★★½☆

Toshiba Areocast apps

Like the Seagate Wireless, when connecting the Aerocast to a PC your only option is to use it as a drag and drop storage device. The Aerocast does have apps for Android and iOS, plus Chromecast compatibility, which enables you to interact with the drive from a number of devices. Using this one is trickier than the Seagate, as there aren't any obvious instructions on how to connect the hard drive to your smartphone or media player. But after a bit of fiddling you'll eventually get there. The Wireless HDD app for mobiles has a slightly nicer layout than the Seagate offering, but one surprising feature is that there is no equivalent app for Windows or Mac, so you have to either access the Aerocast through your smartphone or directly via USB. It unfortunately doesn't have the Seagate's robust functionality, either.

Verdict

Well-designed apps that sadly misstep in a couple of critical areas.

★★★☆☆

WIRELESS HARD DRIVES

$170
WWW.SEAGATE.COM

Seagate Wireless 500GB

Portable streaming for mobile and PCs, but there's a catch.

This friendly-looking drive is made for dumping files that can be shared by both PCs and tablets/phones. It does technically handle this – but without much grace. On the plus side the battery should last for around six hours; enough to let you watch a couple of movies. That's where the praise ends though, as the mobile app (which we tested on Android) is rudimentary and a bit slow, while the desktop software is a nightmare. An 800MB file took close to 10 minutes to transfer via Wi-Fi, and once the file's started transferring there's no option stop it. After files have been uploaded, the folder they're sent to needs to be refreshed to see them.

Verdict

Technically gets the job done, but it's slow and cumbersome.

★★

$269 (RRP)
MYTOSHIBA.COM.AU

Toshiba Canvio Aerocast 1TB

Another impotent wireless hard drive for mobile and PCs

Sometimes, we get tech that seems as though it was designed by a group of people, each with their own design document and ideas. Say hello to a capable piece of hardware that is crippled by inconsistent and unintuitive software. Pictures can be sent from a phone to the Aerocast without issue, but the UI differs for copying music, movies and documents. When the drive is tethered to USB 3.0, it's as quick as the bulk of the drives we tested, with the added bonus of wireless capabilities and a very handy SD card slot, all without blowing its physical dimensions. Our best advice? Avoid transferring anything to this one from a tablet or phone, because it'll leave you fuming.

Verdict

Laughable instructions and infuriating software cripple an otherwise solid performer.

★★

PORTABLE HARD DRIVES

$170
WWW.SEAGATE.COM

Seagate Seven 500GB

It's what's on the inside that counts.

Contemporary portable hard drives tend to be between 10 and 15cm long, 8cm wide and between 1.5 and 2cm thick, depending on the case.

And although the Seagate Seven ticks off two of these same three dimensions, it is only 0.7cm thick – which has an interesting effect on its appearance. Like a starved animal the internal structure of this portable hard drive is clearly visible through the fitted steel casing. In terms of performance the Seven's read and write speeds are similar to other comparable portable drives in this roundup, but considering you can get devices with similar speeds and capacity for $80 the Seven's unique aesthetic comes at a price.

Verdict

The skin-tight suit leaves little to the imagination... and even less to your wallet.

★★★

$399
WWW.LACIE.COM

Lacie Mirror 1TB

Hard drives aren't that interesting, but you are.

Every heard of French designer Pauline Deltour? In the past, she's been commissioned to produce industrial products, furniture, jewellery and public spaces. Here, she's taken a staid appliance and turned it into an *objet d'art* by wrapping mirrors around it. The effect is striking – when it's not covered in fingerprints. An ebony wood display stand is included along with a microfibre cloth and soft carry pouch to keep the Mirror pristine. And that's basically what you're paying for here. Transfer speeds were below-average, though the included software suite for PC and Mac is simple to use, and includes an encryption tool and backup assistant for Windows users.

Verdict

Gorgeous to look at, but with so-so performance you'd have to have a preference for form over function.

★★½

$105
WWW.SILICON-POWER.COM

Silicon Power Armor A65 1TB

Bulletproof vest included.

The Armor A65 form Silicon Power is middle of the road in terms of speed, price and size, and although it has a soft rubbery casing, it still looks like your typical external hard drive.

But it's not every day there's a portable hard drive that is waterproof, dustproof and shockproof. So if you work on a construction site, are thinking of taking a portable hard drive hiking in the Himalayas, or your PC gaming setup simply has more than its fair share of hazards, then the A65 might just be the perfect fit. Though the original formatting gears it towards Windows use, you can configure the drive to work equally well with Apple's OS.

Verdict

A rugged and competent drive that comes with a little extra protection.

★★★½

500GB, $65; 1TB, $90; 2TB, $150
MYTOSHIBA.COM.AU

Toshiba Canvio Basics 2TB

A discount drive for those willing to manually backup.

At the time of writing, Toshiba was offering the bigger 1TB and 2TB Canvio Basics drives for between $10-$20 less than street prices for equivalent WD My Passport Ultra products. Considering the Basics range offers similar read and write speeds, if you can get them at that price, you'd be silly not to. It's worth noting that the Toshiba Basics range don't include any backup software and are simply just plug and play devices that come preformatted for Windows. You can reformat it from NTFS to exFAT using a Windows computer so it'll work on both OSs, but if you think you'll need dedicated backup software then WD's Passport Ultras might still be a better choice.

Verdict

A good entry-level drive that sacrifices software to undercut the market.

★★★★

$120
MYTOSHIBA.COM.AU

Toshiba Canvio Slim II 1TB

An average performer that's stylish and compact.

Grab this compact-looking unit out of its box and you'll be impressed by its pocketable size and feel. Brushed aluminium graces nearly every surface, and it's light-weight, coming in at 150g. What's impressive is that the drive light alters its colour depending on whether you're using it with USB 2.0 or 3.0 – a handy indicator of how fast it'll go. (USB 2.0 is limited to about 30MB/s.) The most unique feature of the Canvio Slim 2 is the suite of third party software as we pointed out on page 49. Coming preformatted for Mac and Windows use, there's also an alternative driver software to allow Apple OS users to read and write in Windows' NTFS format. A great choice if you need full-featured software.

Verdict

A fine range of software and pleasing design make this a hot contender.

★★★★½

500GB, $80; 1TB, $100; 2TB, $160; 3TB, $285
WWW.WDC.COM

WD My Passport Ultra 1TB

Good value, and good at the basics too.

The Ultra is the smallest and most affordable offering from Western Digital, weighing in at just 150g (for the 500GB model) and costing a quite-reasonable $80. The hardware here is top notch, with an attractive external design, plus hardware-based 256-bit AES encryption and, most importantly, decent read and write speeds. And the software suite is likewise a good overall package, with useful tools that cover most basic needs, including backup in Windows. The Ultra's higher-capacity models do take up a bit more physical space, but considering these are premium drives, the price remains comparably low, with the 2TB Ultra only costing around $160.

Verdict

An surprisingly affordable premium drive with good hardware and software.

★★★★

2TB, $400; 4TB, $550
WWW.WDC.COM

WD My Passport Pro 2TB

Lightning-fast, but designed for a rather specific user.

The My Passport Pro is pitched at users who want to store and edit multimedia using an external hard drive. As such, even though it offers extremely fast read and write speeds, but there are a few caveats to look out for. Firstly, the Pro connects via Thunderbolt (more common on Macs than PCs) and though there are other ways of formatting its two internal drives, it performs best in RAID 0 configuration that uses the HFS+J format – and will therefore only work on a Mac. The drive has a built-in fan to keep it cool if you're working from it, though it's a little redundant if you're just using it to backup your PC. And unless you have multimedia work in mind, it might also be hard to justify the price.

Verdict

Lives up to its promises, but is less versatile than Seagate's similar Backup Plus Fast.

★★★★½

$199
WWW.WDC.COM

WD My Passport X 2TB

A drive for Xbox consoles that also works on PCs.

Western Digital has branded this 2TB drive as being for Xbox One or PC gaming storage, and it's a fairly bare bones solution. The Xbox One can use any USB 3.0 drive that's 256GB or above, so we suspect the branding is simply there to catch Xbox owner's eyes. All you get in the box is the drive and a short USB 3.0 cable; there's no software. The drive itself has a vague Xbox One theme, but otherwise it's unremarkable hard plastic. It'd be useful if the drive activity light was on the front, and bigger than a pinhole, but performance wise this is a quicker-than-average-unit. Small packets of data are rapidly flicked back and forth – and that's key for gaming on console.

Verdict

An unassuming drive that's meant for set-and-forget use; the quicker write speed is nice.

★★★★½

$390
WWW.SEAGATE.COM

Seagate Backup Plus Fast 4TB

Going large – and very fast.

What a beast. This is the second heaviest and second largest portable drive in our roundup, coming in at 307g, with two 2TB drives sandwiched together inside. But it also boasts the fastest write speeds by a country mile. This wedge of black plastic is also beastly in appearance, and you'll be happy to tuck out of sight. Having two drives can draw a lot of power, so Seagate has included both regular and Y-cable USB 3.0 cords – a nice inclusion. We also liked the Seagate Dashboard, which ties together cloud-storage suppliers for a unified backup service on your desktop and mobile, and also accesses social media to backup shared images and videos.

Verdict

The initial outlay may shock, but it's great value per GB and super speedy as well.

★★★★★

DESKTOP EXTERNAL HARD DRIVE

4TB, $400; 6TB, $500; 8TB, $700; 12TB, $900
WWW.WDC.COM

WD My Book Duo 12TB

A fast and fair-priced – but immobile – external drive.

Compare the 12TB My Book Duo to the portable drives we tested this month and it looks enormous. And you'll have to be prepared to fork out around $900 for this 12TB model, although smaller options are available; you can pick up the entry level 4TB desktop drive for a more affordable $400. The dual RAIDed drives inside this unit clocked some absurdly fast read speeds, and though the My Book Duo's write speeds were a little slower, they weren't exactly shabby. WD offers decent software and you can easily replace the hard drives in this one if you wish to upgrade in the future. An impressive desktop option if you don't need your storage to go anywhere.

Verdict

If you're willing to keep your drive in the one place, it offers a lot of storage at the right price.

★★★★☆

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BILLION®

All NASs big and small

Nathan Taylor tests a bevy of the latest two-, six-, seven- and eight-bay network-attached storage boxes.

NAS BOX OS REVIEWS

USED IN: NETGEAR NAS BOXES

USED IN: QNAP DEVICES

With all the stuff we're downloading these days, most of us need a little extra storage capacity. Sure, you can crack your PC and install extra hard drives, or start attaching USB drives, but eventually you run out of room. A NAS is frequently a better investment, making downloaded media, personal photos and videos, and other shared media accessible to all. Given their inbuilt support for RAID, they also make excellent platforms for securing your data against drive failures.

Most NASs these days also offer a lot more than file sharing. They're fully-fledged server platforms, capable of transcoding video on the fly, serving web sites, automatically managing and recording feeds from IP cameras and even in some cases, being platforms for virtualisation.

This month we've taken a look at two-bay NASs as well as six-, seven- and eight-bay monsters – for people who need either a little extra storage or a whole lot. But before we do that, we're going to take a quick look at the operating systems they use.

HOW WE TESTED

For each device, we performed a simple copy test and measured both the write and the read speed, in megabytes per second (MB/s). All tests were performed using Seagate NAS HDD 4TB drives.

In the two-bay devices, we tested the devices in RAID 1 (mirrored) mode. For the six- to eight-bay devices we created a RAID 5 setup comprising three drives. Because we used different RAID types, the results aren't directly comparable between the two and six+ results – although it most cases the differences are academic. An awful lot of the NASs have reached the point where they effectively max out a Gigabit Ethernet link at just over 100MB/s.

Netgear ReadyNAS OS 6.2

Netgear's ReadyNAS OS sits somewhere between the extreme flexibility of QNAP and the simple interface of Seagate. It uses a straightforward tabbed interface, although it's not as accessible as these platforms. There's an expectation that you know a little about networking and user and volume management, and it's not the friendliest platform for new users.

On the other hand, it does have something of the extensibility of QNAP and Synology's OSes, with a wide variety of installable apps, including TV servers, download managers, streaming apps and an IP camera surveillance manager, which is weaker than QNAP and Synology's alternative.

There is some good stuff here – not as much as QNAP, but worth adding in. Its true strength is in its cloud and backup support. Netgear's cloud access apps for mobiles are excellent, and it has a VPN access service baked into the OS for secure access to your NAS from anywhere. The automated backup apps are also best in class.

Overall, it's an OS that could be better designed, but it's certainly not lacking in features.

Verdict

★★★½☆

QNAP QTS 4.1

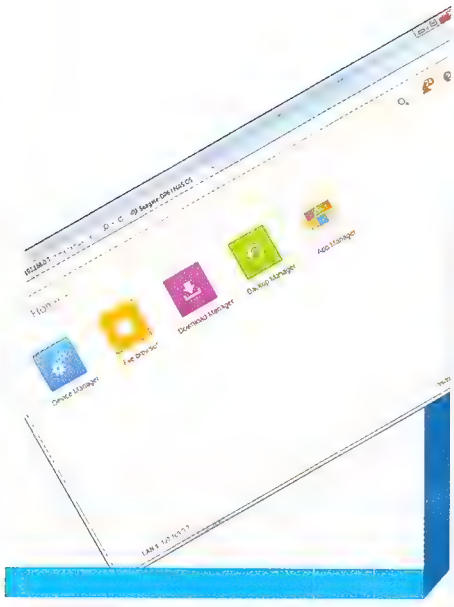
QTS remains hands down our favourite NAS OS, rivalled only by Synology. It's powerful and feature-rich, but manageable for those with no networking experience.

Running on Linux, QTS presents to the user as an operating system within your browser, with movable and resizable windows and all. Components are logically arranged into windows: one for volume management, for example, and another for apps. That last is the real strength of QTS. There's a huge array of application modules that you can install into the operating system. Every type of server app you can pretty much imagine (and many you can't) is there. Adding them is simply a matter of browsing the app menu and installing the ones you want. Installed apps can be enabled or disabled at will.

The first party apps are very strong as well. Video Station (which offers live transcoding) and Surveillance Station (for viewing and managing live IP cameras) are particular highlights. For high-end boxes, there's even a virtualisation platform, into which you can install client OSes and run them through a browser or directly if the NAS had an HDMI port.

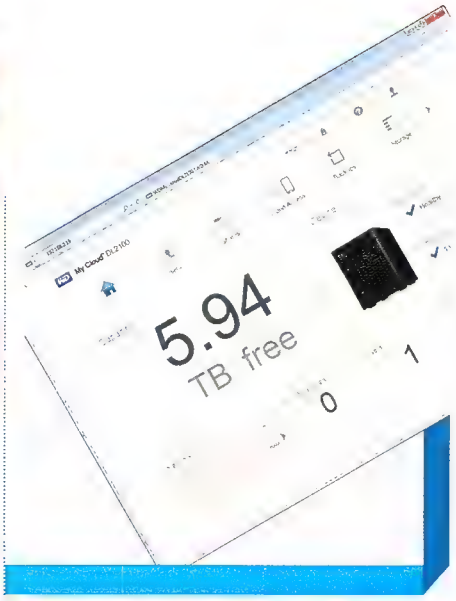
Verdict

★★★★★



USED IN: SEAGATE NAS DEVICES

USED IN: SYNOLOGY AND IOSAFE NASS



USED IN: WD NAS DEVICES

Seagate NAS OS 4

Another OS built on embedded Linux, the Seagate NAS OS focuses more on ease of use than flexibility, with an extremely simple interface compared to the windowed options your find in QNAP or Synology devices. It's not built for someone who wants to run a million apps; it's made for people who just want a file server.

The list of installable apps is extremely short for the platform. At the time of testing, there were just 10, including Plex, a surveillance manager, along with several sync and online backup apps.

The OS supports RAID levels up to 6, as well as Seagate SimplyRAID model, which is essentially a variation on RAID 5 with extendable flexibility. Volumes can be encrypted, although you do take a performance hit, of course.

To go along with the OS, Seagate also provides Sdrive for desktop and mobile platforms. This uses Seagate's cloud service to access the contents of your NAS from anywhere. It's a somewhat raw app, but it works well.

Verdict

★★★½☆

Synology DiskStation Manager 5.2

Built on the same foundation as QNAP's OS, DiskStation Manager (DSM) wears its Linuxness on its sleeve. As with QNAP, when you log on you literally get a full desktop interface, with windows and all.

Its strength is a combination of flexibility and ease of use. Synology walks you through the basics and makes adding and managing add-ons easy. And there are lots of add-ons to explore, from surveillance systems, to IP PBX managers, web servers, video transcoders, streaming servers, peer-to-peer (P2P) downloaders, antivirus scanners and more. It doesn't seem to have quite QNAPs range of first-party or third-party add-ons, but it has most of it.

The interface itself is easy to navigate, with common tool tips and live help as well as a highly customisable appearance. Notifications can be configured and current load and volume usage is readily visible.

Verdict

★★★★½

WD My Cloud OS

Like Seagate, WD focuses on simplicity over extensibility. The core interface is a simple and attractive tabbed affair as opposed to the virtual desktops of QNAP and Synology, and the entire management process is guided by wizards and help systems. Indeed, it hasn't really changed all that much since the days of the original ShareSpace, and that's not really a bad thing. It's just easy.

A number of core extras are built into the OS. There are P2P downloading tools, cloud access for remote and mobile users, backup services to cloud and USB, and user and volume management. There are also a small handful (13 at the time of writing) of third-party apps you can install on the platform – Plex, a few P2P apps and a couple of streaming apps. There are a few useful things in there, but nothing that will blow your socks off.

If you prefer to manage your NAS through simple switches and on/off options, WD My Cloud OS gets it done. If you want a million apps, you won't find them here.

Verdict

★★★½☆

NOTE: TWO-BAY DEVICES WERE TESTED IN RAID 1 (MIRRORED MODE). SIX- AND EIGHT-BAY DEVICES WERE TESTED USING A THREE-DRIVE RAID 5 SETUP

LABS TEST RESULTS

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	55.4	84.9

$170 (DISKLESS) | WWW.DLINK.COM.AU

Bays: 2; Processor and memory: unspecified (ARM-based); Connectivity: one Gigabit Ethernet port, one USB 3.0 port; OS: D-Link ShareCenter OS

TWO-BAY NASs

D-Link Share Center DNS-327L

A basic, affordable NAS.

The DNS-327L is made of very light plastic, which makes it more portable but substantially less durable than most. It's also quiet and relatively easy to install drives into – you just pop the top and slide them down. Getting drives out isn't so easy, however, and you risk the very existence of your fingers when you try.

The hardware is on the minimalist side. There's a single Ethernet port and a single USB port, which can be used to connect a shared printer or serve as a UPS monitoring system.

Compared to the elaborate OSes offered by some of its competitors, the firmware is a simple tabbed affair, covering mostly the basics with some useful help text and guide wizards. We wouldn't be looking to do much more than file serving with this device, and there's not much available in the extra apps department. Essentially, what you get in the box is what you get. Still, the user and volume management is capable and comprehensive, and there is some useful surveillance, backup and automated download software built into the core OS.

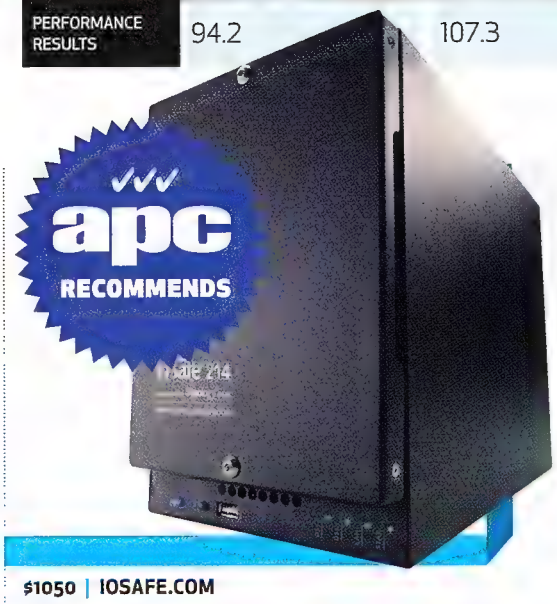
This is a device that's made to be affordable. There are no bells and whistles here, just a device for putting your hard drives on the network, either striped for speed or mirrored for security. If you want apps, and fancy services like surveillance recording or video transcoding, it's not going to have what you need. It performs OK, doesn't cost too much and works well for the basics.

Verdict

It's cheap and good enough for file sharing on a home network. Just don't expect miracles.

★★★

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	94.2	107.3



$1050 | IOSAFE.COM

Bays: 2; Processor and memory: 1.06GHz Dual-Core ARM, 512MB RAM; Connectivity: one Gigabit Ethernet port, two USB 3.0 ports, one USB 2.0; OS: Synology DSM

ioSafe 214

Physical security for peace of mind.

Where most NASs have some features built in for data security, ioSafe appliances are also built for physical security. Like an airplane black box, the ioSafe 214 is built so that it can come through fire and water exposure without harming the drives inside. If the NAS is destroyed, ioSafe's recovery service can still grab the data off the drive. In addition, it's resistant to fire up to 850° and water submersion up to 3m.

We'd venture that it's also theft-proof, given that no thief would bother carrying away this immensely heavy 13kg tank. Or maybe they would, given how valuable the ioSafe 214 is. You're looking at roughly five times the cost of other common two-bay NASs. The internal specs of the ioSafe certainly don't justify this price – it uses a very modest processor and 512MB of memory.

On the upside, it does use Synology's excellent DSM operating system, and configured in Synology's Hybrid RAID (SHR) mode, the drive essentially maxed out the Gigabit Ethernet network on both read and write operations, which is an excellent. But we're not sure it has the horsepower to run some of Synology's more resource-heavy apps.

While the asking price of this NAS is very high, if you can bear the cost, it does provide incredible physical security for your drives. Just one warning, though – changing drives is a major operation, and this is not a product to get if you plan to be swapping drives in and out!

Verdict

If you can get over the price (and weight), the ioSafe is fast and offers excellent physical security.

★★★★

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	75.5	95.7

$300 (DISKLESS) | WWW.NETGEAR.COM

Bays: 2; Processor and memory: ARM Cortex A15 1.4GHz Dual-Core with 2GB RAM; Connectivity: two Gigabit Ethernet ports, three USB 3.0 ports, one eSATA port; OS: ReadyNAS OS

Netgear ReadyNAS RN202

Not one for network novices.

Like the six-bay RN31600 on page 60, the Netgear RN202 was a bitch to get up and running. It didn't like our hard disk – and unlike the RN31600, there was no error code on display to let us know where to look for a solution. It just didn't work with the pre-used hard drive we were deploying for testing, which will no doubt send an awful lot of users back to the shop.

Thanks to our experience with the six-bay device, however, we had a solution (a factory reset) and had it up and running without too much time wasted.

There's certainly some solid hardware in play here, especially with respect to memory, which puts it in good stead for running multiple server apps on the Netgear without sending it into meltdown.

It was fast enough in our tests, and the OS is very flexible with respect to additional apps and features beyond file sharing. User and volume management is fine-grained enough to satisfy any network manager, and the cloud and mobile access features are first-class.

However, as we noted earlier in our look at the Netgear ReadyNAS OS, it's not a tremendously friendly platform for consumers, so if you're not a technical type you might want to shy away from this device, especially when the setup is so finicky.

Verdict

A little more expensive and a little more powerful than your entry-level models.

★★★☆☆

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	80.5	93.4

$190 (DISKLESS) | WWW.QNAP.COM

Bays: 2; Processor and memory: Marvell 6282 1.6GHz and 512MB RAM; Connectivity: one Gigabit Ethernet port, one USB 2.0 port and two USB 3.0 ports; OS: QTS 4.1

QNAP TS-212P

Not as powerful as some.

Plasticky, cheap-looking and using screw mounts (yuck), the TS-212P from QNAP is clearly made to be as inexpensive as possible. The outsides are reflected on in the insides, with a relatively low-end processor and small amount of memory driving the TS-212P.

While our love for QNAP's OS remains undiminished, the TS-212P doesn't have the horsepower to drive its more extravagant apps. Compared to the much more powerful TS-851 reviewed on page 61, the operation of the TS-212P was considerably more sluggish, and we wouldn't want to have to tax it too much with, say, Surveillance Station or Video Station.

Still, it's enough for less demanding tasks like background download, file and media service, backup services and really anything that primarily involves file operation. It's also capable of serving media to and grabbing prictures from QNAP's mobile applications, Qfile and Qmanager.

Its performance in our disk tests was solid enough and comparable to most of the other two-bay devices here. It was quiet during all operations, even intense writing, which speaks well of the inbuilt fan.

Ultimately, we weren't in love with the design or build quality of this QNAP – though it is light at less than 1kg – but the QTS operating system and all the flexibility it provides remains a selling point. Just don't ask too much of it in this case.

Verdict

Ugly and cheap physical design, but the OS remains a selling point.

★★★½☆

LABS TEST RESULTS

PERFORMANCE RESULTS	WRITE (MB/S)	READ (MB/S)
	53.1	91.3

SSD

$200 (DISKLESS VERSION) | WWW.SEAGATE.COM

Bays: 2; Processor and memory: 1.2GHz ARM and 512MB RAM; Connectivity: one Gigabit Ethernet port, two USB 3.0 ports; OS: Seagate NAS OS

Seagate NAS 2-bay (STCT300)

Easy, affordable file sharing.

Using the same elegant screwless case design as the NAS Pro line, the lower-end NAS line from Seagate doesn't offer the flexibility of some of its competitors, but works well as a plug-and-go file server.

The difference between the Seagate NAS and NAS Pro (which we reviewed on page 61) lines seems largely to be in the underlying processor and memory configuration. Where the NAS Pro line has Intel x86 multi-core processors, the NAS devices like the STCT300 have 1.2GHz ARM processors and just 512MB of memory, which is less than a low-end smartphone. The power consumption is correspondingly low, requiring just 16W even in full flight, which made us wonder why it has such a powerful (and often too loud) fan built in.

The low-end processor didn't hurt the STCT3000's file performance too much, although the write speed was comparably slow. The read speed was more than decent over Gigabit Ethernet, however.

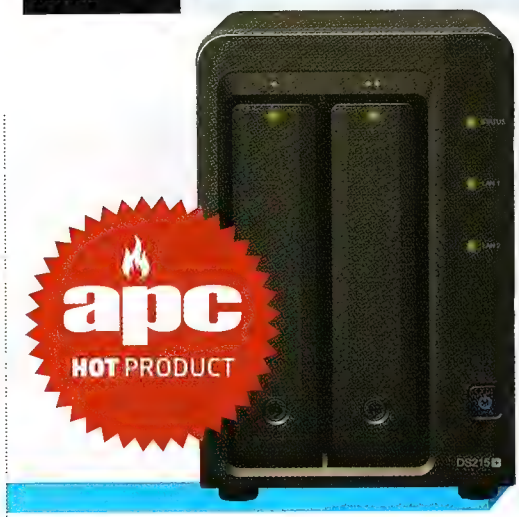
As with other Seagate devices, if you're looking for much beyond file sharing, you're likely to be disappointed. It's not the app-toting powerhouse of QNAP or Synology. It doesn't have a million options, and it doesn't have the power to run them if it did. However, it's very easy to use, simple and quick to set up, and does what it sets out to do – file serving – very capably.

Verdict

Affordable and simple, for people who want nothing more than file sharing.

★★★☆☆

PERFORMANCE RESULTS	WRITE (MB/S)	READ (MB/S)
	103	110.2



$440 | WWW.SYNOLOGY.COM

Bays: 2; Processor and memory: Annapurna Labs Alpine AL-212 dual-core 1.4GHz and 1GB RAM; Connectivity: two Gigabit Ethernet ports, two USB 3.0 ports; OS: Synology DSM

Synology DiskStation DS215+

Great performance and features.

Synology seems to have a knack for getting the best out of the installed hard drives. Even though this is only a mid-range product (it's technically part of Synology's business line, although the OS is the same as the consumer products), it produced the best performance results of any of the two-bay NASs here.

It's not just drive performance that the DS215+ has going for it, either. Like all Synology devices, it runs the outstanding DSM OS, with its many add-ons, ease of use and flexible interface. It comes with two camera licences for the excellent Surveillance Station app, which manages and records feeds from IP cameras.

On the hardware side, it runs on a dual-core ARM processor (similar to the one used in the physically identical DS715 reviewed on page 62, but with two rather than four cores) with 1GB of memory. We had no problem running multiple apps at once, including Surveillance Station, without redlining the CPU or memory or causing the interface to become sluggish.

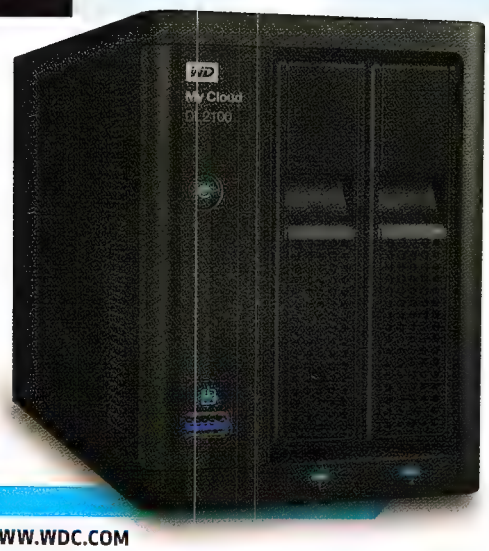
That said, we're not sure that the performance and two Ethernet ports of the DS215+ really justify the fact that it costs more than twice as much as the QNAP and Seagate devices. Maybe if you really do want to push the performance (especially with Surveillance Station), it may be worth it, but for pure file sharing most users will probably pass.

Verdict

It's expensive, but it's got it where it counts.

★★★★½

PERFORMANCE RESULTS	WRITE (MB/S)	READ (MB/S)
	67.1	85.8



$580 | WWW.WDC.COM

Bays: 2; Processor and memory: Intel Atom C2350 1.7GHz and 1GB RAM (expandable to 5GB); Connectivity: two Gigabit Ethernet ports, one USB 3.0 port, one USB 2.0 port; OS: WD My Cloud OS.

WD My Cloud DL2100

Expensive for what's on offer.

Part of WD's 'business' range of NAS appliances, the My Cloud DL2100 is differentiated from the consumer options largely by the inclusion of a second Ethernet port, a second power port (for reliability) as well as iSCSI and UPS support. It also boasts a slightly more powerful processor than most of the ARM-toting consumer appliances – it runs on a 1.7GHz Intel Atom with 1GB of memory (upgradable to five). Still, those upgrades probably don't justify the price premium for most users.

During testing, the device suffered from weird and inexplicable pauses on the copy operations, which drove down its average transfer times. When it was at full flight, it would essentially max the Ethernet link, but then it would pause and the average speed would drop. Still, the DL2100's final test results are competitive despite that.

Running WD's My Cloud OS, it's extremely easy to set up and manage, even if it doesn't have the kind of options you'll find in the more Linux-ish competitors. If you're primarily interested in file sharing, this is a good option. But as we noted earlier, the add-on options for WD NASs are a little anaemic, with only a handful of third-party tools available (and some of those are seriously outdated).

If you want more than a device that does file sharing and media service, then you may be better off looking to a NAS with a more extensible OS.

Verdict

It may have a few extra business-friendly capabilities, but they don't really justify the price premium.

★★★

Four- and five-bay NAS boxes: what to buy

Two-bay too small and six-bay too big? Here are our mid-range NAS recommendations.

For readers thinking our focus on testing two-bay and six-or-more-bay NAS boxes this month leaves a somewhat sizeable hole in the picture, *APC* did a roundup of four- and five-bay NASs just two months back (see 'Mega media storage boxes' on page 72 of the July issue), so we didn't want to go over old ground. In the interests of saving space, here's a very quick summary of that feature and what we thought was worth buying in this space.

ASUSTOR's four-bay AS5004T at $550 was our overall top recommendation, scoring 4.5/5 and thus winning our coveted 'Hot product' award. It impressed us in almost every area. It's got very good core hardware in its dual-core 2.4GB Celeron, 1GB of DDR3 memory (upgradable to 8GB) and dual Gigabit Ethernet ports, plus an excellent range of features (hot-swappable drive bays, three USB 3.0 ports, link aggregation) and great overall performance; it had the highest read speed of the bunch at 108.4MB/s and was only just pipped in write speed by the WD My Cloud EX4100 in write speed (109.2MB/s vs 110.8MB/s). It was particularly strong with media-centric features, with both HDMI video and S/PDIF audio outputs in the back, and an IR reciever in the front, which allows you to use it from the couch via a remote control.

But it wasn't the only product that scored an award, however — five other vendors also had pleasing products that gained our '*APC* recommends' award. Here's a quick rundown of what those are, and the pros and cons of each.

NETGEAR READYNAS RN10400

$250 | www.netgear.com.au

This is an attractive little four-bay unit that, while not the fastest (with reads and writes at 90.4 and 80.8MB/s, respectively), offers a huge range of software features and enough hardware options to suit most users. Great bang for buck.

QNAP TS-451 4G

$720 | www.qnap.com

It's a little more pricey, but QNAP's four-bay NAS has some unique top-shelf features, like support for IP camera recording, 265-bit AES drive encryption and the ability to record TV if you plug in a USB tuner. And performance was solid, too.

SYNOLOGY DS415PLAY

$605 | www.synology.com

The DS415play is aimed at media aficionados, with its flagship feature its ability to transcode 1080p video on the fly. Its hardware features are adequate, although it only has a single Gigabit Ethernet port; however, that didn't really affect its transfer speeds in our testing.

THECUS N5810PRO

$1,200 | www.thecus.com

With a dual-core Celeron processor, 4GB of RAM and five Gigabit Ethernet ports (yes, really), plus a built-in UPS, HDMI output, IP camera support, encryption, virus scanning and more, the N5810PRO may cost more, but it's basically a full-featured server suitable for demanding multi-user home or work environments.

WD MY CLOUD EX4 PERSONAL

$500 | www.wdc.com

You can get the EX4 with up to 16TB of drives included, has automatic backup software, cloud storage syncing and excellent easy-to-use mobile and desktop apps.

LABS TEST RESULTS

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	96.7	99

apc HOT PRODUCT

$970 (DISKLESS) | WWW.ASUSTOR.COM

Bays: 8; Processor memory: 2.41GHz Celeron and 1GB RAM; Connectivity: four Gigabit Ethernet ports, three USB 3.0 ports, two USB 2.0 ports, two eSATA ports, HDMI; OS: ADM 2.0

SIX- AND EIGHT-BAY NASs

ASUSTOR AS5008T

Generous on the connectivity.

A tad larger than it needs to be, the AS5008T arranges its eight drives in twin stacks. Combined with the screwless clip-in trays, this configuration makes it very easy to install and swap drives – a nice change from some of the more finicky NASs we've looked at here.

This is a device that's bustling with ports. There are no less than four Gigabit Ethernet ports with load balancing across them, two eSATA ports, an HDMI port and five USB ports. Internally, its specs are very similar to the QNAP TS-851: a 2.41GHz Celeron combined with 1GB or memory that's upgradable to 8GB.

That's not the only similarity. ASUSTOR's ADM OS is built on the same backbone as the QNAP and Synology OSes, and it shows in both the interface and the array of installable apps from the App Central interface. It's an excellent platform, functionally and aesthetically similar to the QNAP and Synology OSes and very flexible when it comes to configuration and apps. ASUSTOR doesn't have quite the array of first-party tools that those platforms do, but it's still very capable, with surveillance, media streaming, downloading, backup and many more tools available.

Its performance was excellent in our tests, managing to achieve very close to 100MB/s for both read and write operations to a RAID 5 setup. That, combined with all its ports and extensible software, makes this one of our top picks in the eight-bay space. A good buy.

Verdict

Affordable, flexible and with ports coming out the wazoo. Worth it.

★★★★½

LABS TEST RESULTS

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	97.9	101.2

$900 | WWW.NETGEAR.COM.AU

Bays: 6; Processor and memory: Intel Atom 2.1GHz dual-core with 2GB RAM; Connectivity: two Gigabit Ethernet ports, two USB 3.0 ports, one USB 2.0 port, two eSATA ports; OS: ReadyNAS OS

Netgear ReadyNAS RN31600

Complicated initial setup.

Looking all swanky in with its open-door case, LCD screen and touch controls, the new Netgear RN316 was slow to boot, but did it look fancy when it did. This six-bay appliance is certainly larger than it needs to be, but you may not care when it looks this funky.

There's certainly a lot to recommend it. The OS is speedy and flexible, with excellent cloud access support – either through Netgear's own service or via direct VPN connection. The hardware is certainly capable, with a 2.1GHz processor and 2GB of memory built in. Even in RAID 5, it hit our Gigabit Ethernet limit, and there's plenty of memory for additional services to run. Unlike WD and Seagate, Netgear does indeed have quite an extensive array of additional first- and third-party apps available, so there's plenty to tinker with here.

The initial setup of the ReadyNAS wasn't much fun at all, though. Apparently it didn't like that we'd used the disks before, and gave an inexplicable error message to that effect. We had to dig deep through the Netgear help system to find how to fix the problem (which involved holding down the reset button while booting to get to the boot menu). It was silly, and not a problem any other vendor had.

Setup problems aside, we were impressed by the ReadyNAS. It could have made more and better use of its on-box controls, and the OS could be easier to use, but you're not missing out on anything once you get it running.

Verdict

The OS isn't the best, but the hardware is capable and looks funky.

★★★½

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	95.7	88.8

$1050 | WWW.QNAP.COM

Bays: 8; Processor and memory: Intel Celeron 2.41GHz Dual-Core, 1GB RAM (with two additional upgrade slots); Connectivity: two Gigabit Ethernet ports, three USB 3.0 ports, two USB 2.0 ports, HDMI; OS: QTS 4.1

QNAP TS-851

Good performance and features.

Plain and unadorned by fancy LEDs and such, the TS-851 delivers good performance and supporting multiple running apps, but isn't enough to support some of the more extreme features that are technically available in the OS, like 4K transcoding and virtualisation (though the latter might be possible if you upgrade the memory using the two internal memory slots).

The strength of QNAP's operating system is on display here, with its easy setup and configuration combined with nearly limitless customisation. The Surveillance Station and Video Station are particular highlights, and the Intel Celeron processor that drives it makes the operation of the OS very snappy. It certainly could have used more memory in the default configuration, but it's possible to buy an additional memory card for the unit (a version with 4G is also sold directly by QNAP).

It proved extremely capable as a file server, coming fairly close to the practical limits of our Ethernet network. Weirdly, its read speed was slightly lower than its write speed, but both were more than fast enough.

For a little over a grand for a very capable eight-bay device, the QNAP TS-851 is a very good deal indeed. Whether you just want a file server or a capable application server, it gets the job done and is among our top picks for large NASs.

Verdict

Snappy and extremely capable, it offers a tremendous feature set and good performance.

★★★★½

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	85.7	108.3

$910 (DISKLESS) | WWW.SEAGATE.COM

Bays: 6; Processor and memory: 1.7GHz dual-core Intel, 2GB RAM; Connectivity: two Gigabit Ethernet ports, two USB 3.0 ports, one USB 2.0; OS: Seagate NAS OS

Seagate NAS Pro 6-Bay (STDF300)

A good-looking NAS for file serving.

Compact and elegant in piano black, with an information LCD embedded in the front, this is certainly one of the most attractive NAS devices we looked at here. It's also very easy to set up, with readily accessible screwless drive bays and a wizard that will walk NAS beginners through the basic setup process.

Managing the NAS during operation is also breezy, since Seagate's OS is more user-friendly than pretty much any other NAS OS we've seen. Where some of the competitors like to pack in features, Seagate has deliberately kept things lean. It doesn't do so much, but what it does, it does well.

Internally, the NAS Pro runs on an unspecified Intel 1.7GHz processor and 2GB of memory, which isn't quite the powerhouse that some of the competitive NASs can boast, but also makes the STDF300 affordable. It's more than enough to for file sharing and the limited array of apps that Seagate offers, and it certainly didn't hurt the performance of the write operations. According to Seagate, it burns about 85W of power with six drives in full operation.

It supports your regular RAID levels as well as RAID 6 and 10. We tested using a share created on a three-drive SimplyRAID setup, which is a scalable variation on RAID 5. And it was very fast, writing data at nearly 86MB/s.

As you'd expect with a device from Seagate, you can buy the NAS with disks built in, but a diskless version is also offered.

Verdict

It's fast and it's simple. If you don't need much beyond file sharing, it's a very good buy.

★★★½

LABS TEST RESULTS

	WRITE (MB/S)	READ (MB/S)
PERFORMANCE RESULTS	101.1	107.6

DS715, $560; DX513, $565; $1,125 FOR BOTH
WWW.SYNOLOGY.COM

Bays: 2+5; Processor and memory: Annapurna Labs Alpine AL-314 quad-core 1.4GHz and 2GB RAM; Connectivity (DS715): two Gigabit Ethernet ports, two USB 3.0 ports, eSATA port (used to link to DX513); OS: Synology DSM

Synology DS715 + DX513

A fast, spacious combo.

On its own, the Synology DS715 wouldn't fit into this section of the review. After all, it only has two drive bays. But when you combine it with the DX513 drive expansion, you get something much more – an effective seven-bay NAS device.

The DX513 is an example of an eSATA extension box. It's essentially a passive device, relying on a host system (in this case, the DS715) to manage it. Meanwhile, the DS715 is a NAS with enough horsepower and the right software to manage seven drives. It supports RAID 6, and all seven drives can be placed in a single array.

On both the main box and expansion box, drives are installed using a screwless tray arrangement with individually lockable bays. Thankfully, Synology maintains a consistent aesthetic design, so the devices actually look pretty good together (if that kind of thing matters to you).

We built the RAID 5 setup in the DX513 to see how that might affect the performance of the system. Even though the drives were housed in an external box, it had no apparent impact on the copy performance of the Synology in our tests. With the quad-core processor in the D715, the volume blazed at top speeds for both read and write operations. Ethernet was the limiting factor here, as it was in so many of the NAS servers we tested.

Verdict

A combo that gives you seven drives in total. It's very fast and extremely capable.

★★★★½

The plugin interface of FreeNAS.

Roll your own NAS server

If you're the tinkering type who prefers to make their own stuff, then you really don't have to buy a packaged NAS.

You can very well make your own — after all, a NAS is really just a PC with a customised OS and lots of hard drive slots, and there are some excellent specialised versions of Linux for doing just that.

The two most notable are FreeNAS (**www.freenas.org**) and Amahi (**www.amahi.org**), both of which are designed to operate as 'headless' (no monitor) NAS operating systems. Once installed, they're controlled by a tabbed web interface.

Of the two, Amahi is the easier to use and has the greater variety and number of plug-ins/apps for additional features beyond basic file serving. It's beginner-friendly and its deep bench of easily installed apps is pretty darn great. Some of those apps do cost money, however (typically a small fee).

FreeNAS is better suited to serious business environments, with greater reporting and fine-grained control over NAS features as well as volume encryption. Its plug-in suite is much more limited than Amahi and if the thought of ever having to use Linux shell commands terrifies you, it may be best to stick to Amahi.

RAID beyond level 5

Once you get to devices with six or more bays, you may start encountering new RAID levels.

The basic RAID levels are RAID 0, which is striping data across multiple drives for extra performance; RAID 1, which mirrors drives; JBOD which concatenates drives into a single volume; and RAID 5, which adds parity data so that one drive in the array can fail without you losing data.

But as we get to larger drive arrays, new possibilities arise. First up, there's RAID 6, which is like RAID 5, except that two drives can die without you losing any data. The cost is the capacity of two drives. For example, a six-drive array made up of 4TB drives in RAID 6 would have a storage capacity of 16TB. And calculating and writing the extra parity data does cause a performance hit during write operations.

Then there's nested arrays. Let's say you had a six-drive NAS and instead of one array you made two RAID 5 arrays of three drives each, then you put those two virtual volumes in a RAID 0 setup in order to improve their performance. You'd have a configuration known as RAID 5+0, or RAID 50. Likewise, RAID 6 arrays nested in a RAID 0 array would be RAID 60. There's even RAID 10 (mirrored volumes arranged in a stripe) and RAID 100 (mirrored drives arranged into RAID 0 stripes, which are in turn striped again).

The permutations actually become quite mind-boggling when you get up to this level. Ultimately, even if your NAS supports it, we'd suggest most users stick to the non-nested RAID levels: RAID 5 for a four-drive NAS, RAID 6 for six or more bays. It keeps things simple, and for most people, write speed isn't that important.

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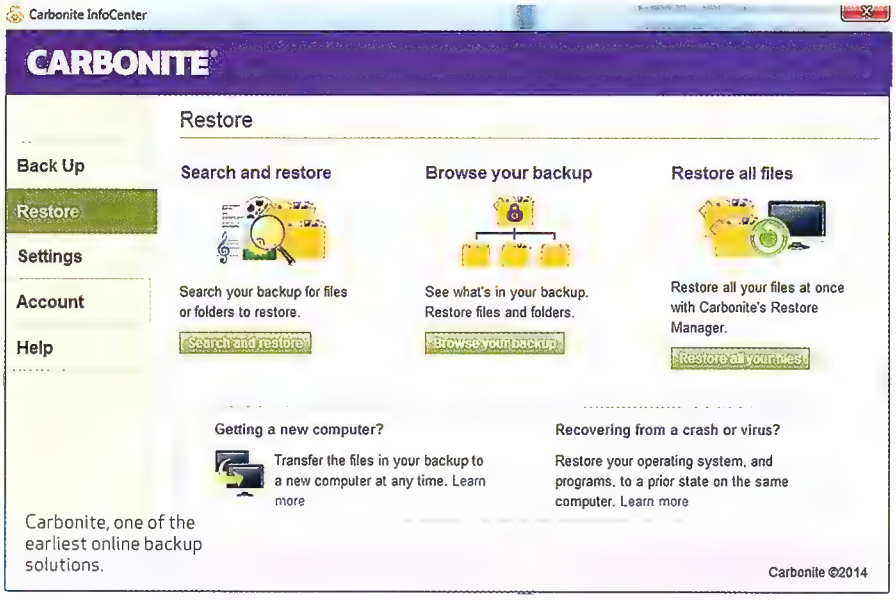
Cloud storage: sync vs backup

Nathan Taylor explains the benefits of storing your data in the cloud.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Carbonite, one of the earliest online backup solutions.

If you were to ask us, "What's the best way to protect my data?" or "What's the easiest way to share my data with friends and between my devices?" in both cases the answer we'd give would be simple: cloud storage.

Cloud storage services have been kicking around for a while now, yet it still surprises us how few people actually take advantage of them. Fierce competition has driven down prices to very affordable levels, and there are even free solutions that offer substantial storage capacities.

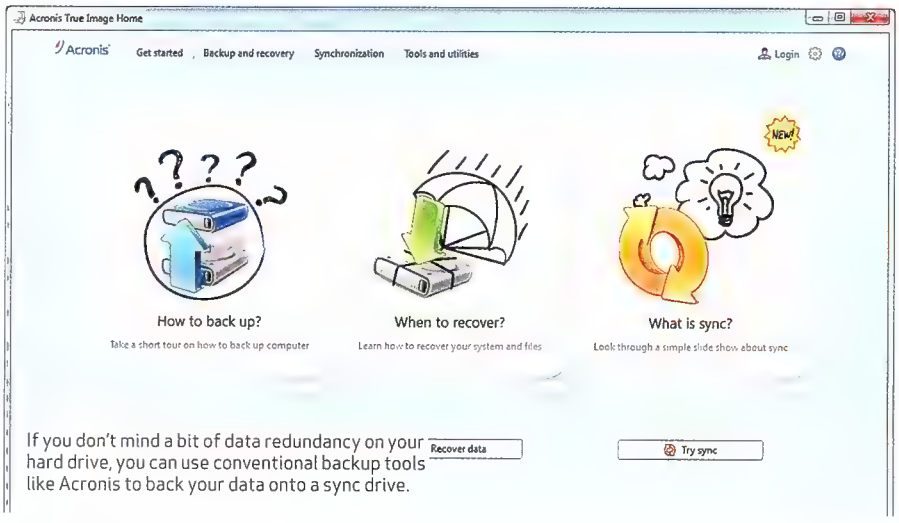
These systems are a very safe way to store your previous data, just as long as you use good passwords and maintain reasonable security measures. The biggest advantage, of course, is that your data is stored off-site, so that the theft, damage or loss of your hardware doesn't also mean you'll lose your data.

But that's not the only advantage. Cloud services let you get your data to and from your mobile devices easily. They're managed by storage security professionals, and are generally kept in data centres with backups and redundancies. And they often let you share files as easily as sending someone a link.

The downside of using cloud storage comes down to a single word: bandwidth. Right now in Australia we don't have nearly enough of it, so we still have to be judicious about what we store in the cloud. For example, uploading your entire video collection is probably not an option, and full system backups to the cloud can literally take months of uploading to complete the first time around. As we move to the NBN, that's likely to change for some users, but for now, you do have to be mindful of how much of your monthly internet quota is being used for cloud storage and access.

SYNC-AND-SHARE DRIVES VS BACKUP DRIVES

Broadly speaking, there are two flavours of consumer cloud storage systems: sync-and-share services and backup services.



If you don't mind a bit of data redundancy on your hard drive, you can use conventional backup tools like Acronis to back your data onto a sync drive.

You may be more familiar with the sync and share model, since it's used in common tools like Dropbox, Google Drive and OneDrive. These services let you mirror directories on your computer with the cloud drive, where anything you put in the directory is copied to the drive. Remove something from the directory, and it comes off the drive, too.

These services also have a share functionality, allowing you link mobile devices to the cloud drive and access data and upload photos from your mobile to the drive (which, of course, is then mirrored back on your PC). You can share data with other people as well, either through a URL or, if they're a user of the same service, by linking your cloud drive directories with theirs, creating a shared directory. In this way, anything you put in the shared directory will be available to both users.

The other type of cloud storage service is the backup service, which tend to work a lot like regular backup applications, but instead of having, say, a USB hard drive as the backup target, you have the cloud drive. These services will actually come with the

BitTorrent Sync

So you're not all that keen on having someone else keep your data, or don't want to pay the sub fee for storage? In that case, you can try out BitTorrent Sync (**www.getsync.com**), a tool that lets you create your own cloud drives and share them with your other PCs, mobile devices and other Sync users. The app is very easy to use and allows you to share and sync unlimited amounts of data.

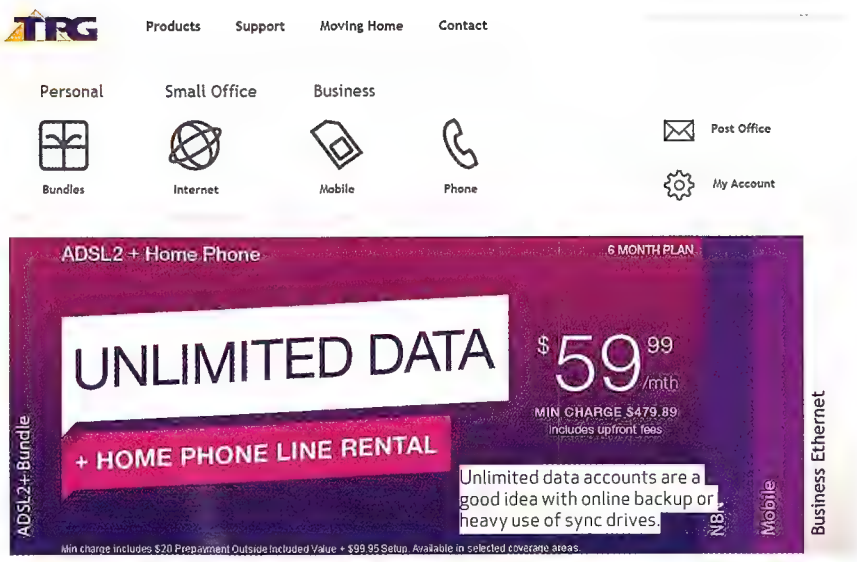
Making the most of sync services

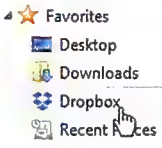
Here are some quick tips for using your sync services:

- Install it on all your devices. Most services support smartphones while some even support Wi-Fi cameras, and they make a very easy and convenient way to get photos and other mobile data to your PC.
- Run the tutorial and explore the app's features. There's often much more than you think, like linking your directories with other users', or right-clicking on a link in Explorer and generating a URL that you can email to someone (even someone who doesn't have the service) for easy file sharing.
- Talk to you friends and family about it. The more people that you know who use it, the more useful it is. Being able to share baby photos with all your family just by copying them to a directory on your hard drive beats the hell out of uploading them all to Facebook!
- Remember that you can use it for backup as well as syncing. There's a great little tool from Microsoft called SyncToy (**tinyurl.com/6mtraua**), which allows you to mirror directories in Windows. For example, you could mirror your Pictures directory with a sub-directory in Dropbox.

backup app that you download and install on your PC. In that app, you'll set the directories you'd like to back up and it will upload them to the cloud for you, with periodic or continuous updates as files change. If disaster strikes, you can then use the app to get lost files back.

We should note that often the lines between the two types of services are blurred. Most backup services allow you to access the contents of your backup archive from a mobile or web interface, and you may even be allowed to share individual files. Likewise, you can technically use a sync-and-share service for backup, simply by making it the target destination in your backup app. For example, if you use Acronis or CrashPlan or any of the other automatic backup apps, you could set your shared directory (say, 'C:\Users\username\Dropbox') as the backup target, which will then be synced to the cloud. It's not space efficient, as you'll have two copies of your data on your hard drive (the original and the backup), but it works.





Most sync drives add a special folder to Windows Explorer. Anything you copy to it is saved to the cloud.

ABOUT THE REVIEWS

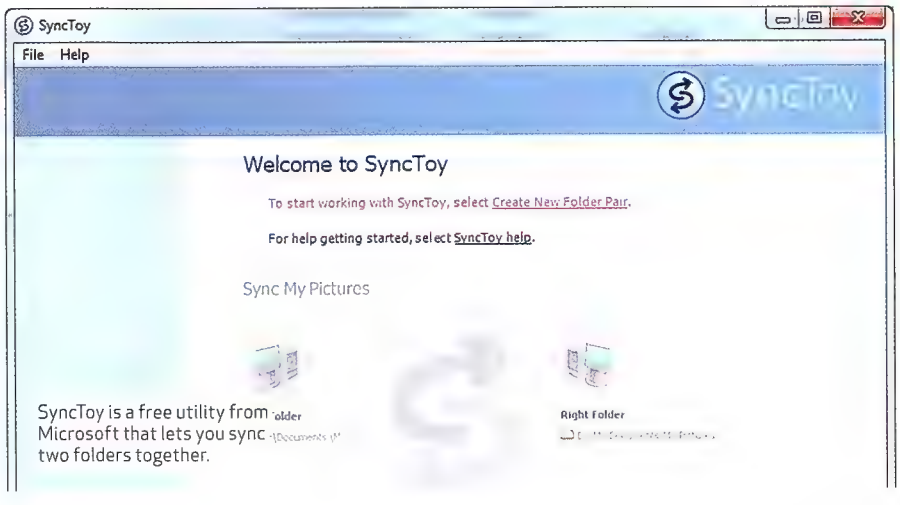
There are a huge number of both sync- and backup-oriented cloud services around now, and we don't have nearly enough room to cover them all, so for this feature we've focused on what we think are the biggest (and often best) options.

For sync services, that means the big four: Microsoft, Google, Dropbox and Amazon. If you want to explore beyond those options, however, you can check out services like Copy (**copy.com**), Tresorit (**tresorit.com**) and Box (**box.com**) among others.

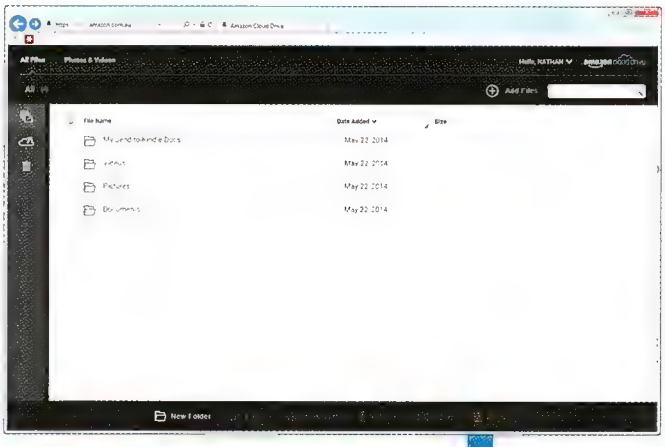
In the backup space, we've likewise fully reviewed four of our favourites, although there are many more you can check out if you've a mind, including Carbonite (**www.carbonite.com**), Mozy (**mozy.com**), IDrive (**www.idrive.com**), Backblaze (**www.backblaze.com**) in addition to SOS Online Backup (**www.sosonlinebackup.com**).

Getting the best of backup services

- Be judicious about what you back up. Uploads in Australia are slow, so it's unlikely that you'll be able to back up your downloaded video collection.
- Be patient. The first backup can be brutal, taking days or even weeks. Subsequent backups only upload changed files, so they are much quicker.
- Be mindful of your monthly quota. You can burn through it quickly with a backup service. Even if the app supports it, it's probably best to turn off continuous backups if you're on a quota.
- Most backup systems focus on your Users directory, where all your user data is stored. Keep any media you want backed up in your user directory and you should be good. Otherwise, you'll need to specify in the backup app any additional directories you want backed up.


SyncToy
File Help
SyncToy
Welcome to SyncToy
To start working with SyncToy, select Create New Folder Pair.
For help getting started, select SyncToy help.
Sync My Pictures
SyncToy is a free utility from Microsoft that lets you sync two folders together.

SYNC-AND-SHARE CLOUD DRIVES



CLOUD DRIVE

UNLIMITED PHOTOS PLUS 5GB GENERAL STORAGE, US$11.99/YEAR; UNLIMITED, US$59.99/YEAR | WWW.AMAZON.COM/CLOUDDRIVE

Amazon Cloud Drive

No free option available.

Just as with Google and Microsoft, if you have an Amazon account, you also automatically have an Amazon Cloud Drive account – although Amazon recently changed all of its plans and no longer offers a free account. However, the 'Send to Kindle' feature for personal documents doesn't count towards your storage limit anymore.

Functionally, it's very similar to the other services, with a local app you can install on your PC and mobile devices, as well as a web interface to your files. We do particularly love the web interface for Amazon, and it even supports dragging and dropping files to upload – although that's a little redundant with the local app installed.

It also supports the ability (like Dropbox) to generate URL links to files and directories that you can email to others. Still, the creation and management of shared files and folders in Amazon is well behind that of Dropbox, and if you're looking for a collaborative shared directory setup, we'd strongly recommend Dropbox or one of the other services.

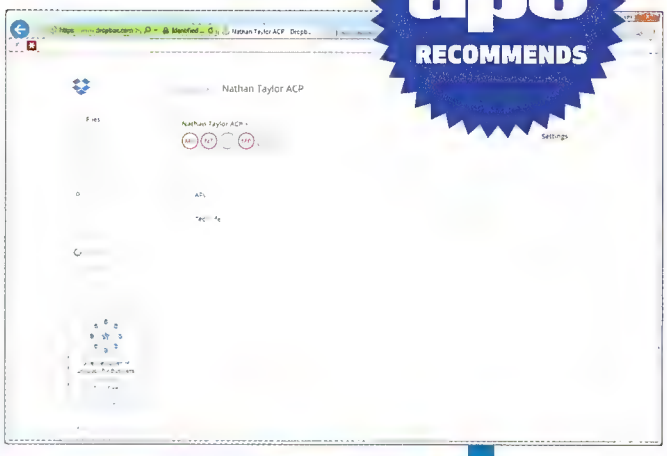
Amazon does have a major advantage for Kindle owners, it must be said. Getting non-Amazon ebooks onto a Kindle is made much easier with the Cloud Drive, since you can just copy them to your Kindle directory to have them uploaded.

Verdict

We don't love the way folders are shared with other users, but the service is otherwise solid.

★★★½

apc RECOMMENDS



CLOUD DRIVE

2GB FOR FREE; 1TB, $12.99/MONTH | WWW.DROPBOX.COM

Dropbox

Excellent support for a number of platforms.

Dropbox is seen as the grandaddy of syncing services, although Box is technically older. Its clean app design, wide platform support and surprisingly deep multi-user feature set are still the benchmark that other services need to chase.

We love how easy the mobile apps are to use, and the way you can very quickly share files and directories with non-Dropbox users just by right-clicking on them in Windows Explorer and selecting 'Share Dropbox link' from the menu.

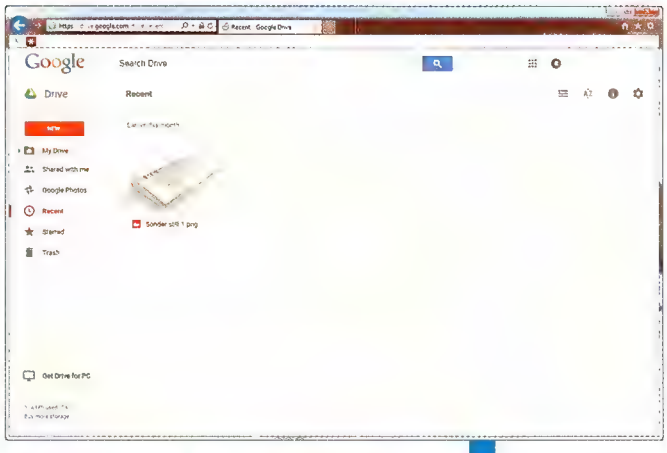
Subtle features, like the new 'File Request' feature (which sends out an email asking for a file, which the recipient can then upload to your Dropbox), access to multiple versions of files, document commenting and the Carousel gallery sharing feature are great additions and really keep Dropbox just that step ahead when t comes to file sharing. While we don't love its web interface compared to OneDrive in particular, it's still very easy to use.

Still, it has a rough battle ahead. Where OneDrive is built into Windows 8 and 10, and pretty much everyone has a Google account now, you'll have to actively convince your friends and relatives to install Dropbox. Which may be hard, since Dropbox is rather stingier with its free account, offering only 2GB.

Verdict

Great for features and platform support, but it needs a more generous free account limit.

★★★★



CLOUD DRIVE

15GB FOR FREE; 100GB, US$1.99/MONTH; 1TB, US$9.99/MONTH
WWW.GOOGLE.COM.AU/DRIVE

Google Drive

Free web-based productivity tools.

Anybody with a Google account (ie. everybody) gets 15GB for free on Google's Drive service, and more capacity can be purchased at a rate of US$9.99 per TB – up to 30TB. It should be noted, that capacity is shared with Google Mail and other Google Apps, so a big Gmail archive may eat into it somewhat.

It's fair to say that Google still lags behind both OneDrive and Dropbox when it comes to the interface. Compared with the simple elegance of those services, Google Drive is a little obtuse, although the basic functionality is pretty much the same. You install the PC app and a shared folder will appear; anything you put in it is uploaded. The unadorned mobile apps automatically upload your photos and give you access to any files in your Drive.

There are some neat touches. There's integration with Gmail, which allows you to save your email attachments directly to the Drive. There's also the offline support on mobile devices, which lets you flag favourites to be accessible when you're not connected.

Probably its biggest selling point, however, are the free web-based productivity tools it provides. Google Drive has a spreadsheet (Sheets), word processor (Docs), presentation tool (Slides) and more that can be used to work on documents stored in the drive without ever installing an app on your PC.

Verdict

It's not as elegant as OneDrive or Dropbox, but Google Docs, Sheets and Slides are a major bonus.

★★★½☆

apc HOT PRODUCT

CLOUD DRIVE

15GB FOR FREE; 100GB, $2/MONTH; 200GB $4/MONTH, 1TB (PLUS OFFICE 365), $9/MONTH | TINYURL.COM/N7269TE

Microsoft OneDrive

The best web interface out there.

Microsoft's entry into the world of sync-and-share was is built into Windows 8 and 10 and comes with every Microsoft account. Microsoft has done a great job of improving it since launch, and it's now our top pick of the big three on both features and price.

OneDrive's great strength is its web interface, which is the best of the major sync drive suppliers and likely the best cloud storage interface, period. Its tools for viewing, sharing and organising files are second to none – particularly when it comes to photos, with features like automatic tagging and sorting.

It works well with a lot of Windows apps, including Office, and also integrates smoothly into the Windows 8 Modern UI, which is not something that can be said for Google or Dropbox. It can sync your PC settings, have files tagged for offline access on mobile devices and serve as a backup target.

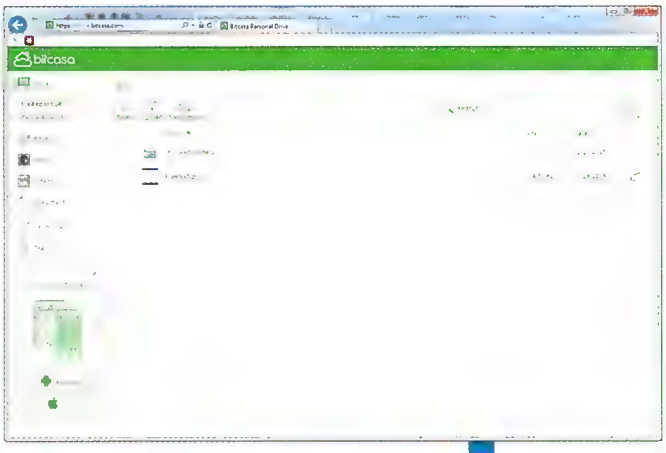
Like Google, Microsoft has an online office suite associated with the service, although in this case it's not available with the free account. With a $9 per month subscription, however, you can get 1TB of storage along with Office 365. Outlook mail is available with the free service, however.

Verdict

Its superior file organisation and Windows integration make this our top pick for Windows users.

★★★★½

CLOUD BACKUP SERVICES



CLOUD DRIVE

1TB, US$10/MONTH | WWW.BITCASA.COM

Bitcasa Personal Drive

Offers both backup and sync.

Bitcasa Drive is a hybrid service, offering both backup and sync in the one application. It's not perfect at either of them, but if you just want to pay one subscription for both kinds of services, it's a solid option.

As a sync drive, it works like Dropbox or Google Drive. It creates a directory on your system that serves as the sync root. Anything you copy into that directory is uploaded to the cloud drive. You can also generate links to files and folders that you can send to other people for easy sharing. You can do this from Windows or the web interface, and such files can be password-protected.

What makes Bitcasa a backup tool is the addition of one simple feature: the Mirror folder option. Once it's installed, you can right click on a folder (say, your User folder) in Windows Explorer and choose to have Bitcasa mirror that folder. The folder is then copied to the cloud drive, and a symbolic link to it is placed in the Bitcasa folder.

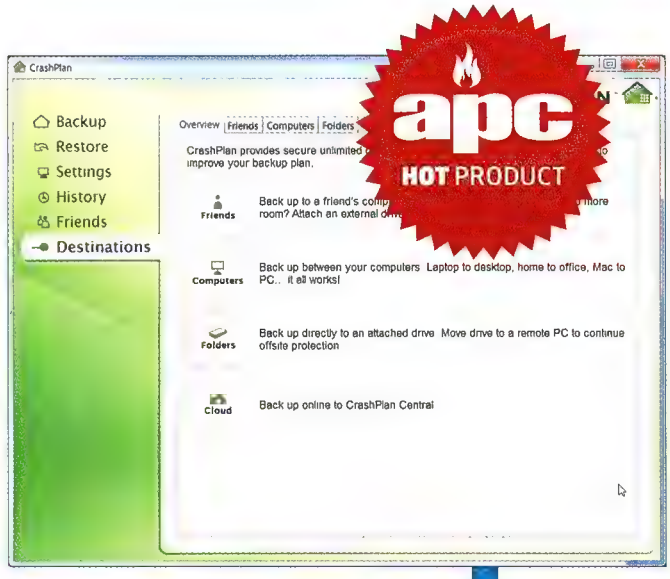
The mirror is one way. Changes to the original folder are reflected in its mirror on the Bitcasa drive, but you can't modify the files in Bitcasa and have them reflected back to the original. This way, accidentally deleting files from the Bitcasa drive won't cause any damage to your PC.

With that feature, Bitcasa turns into a low-end backup system. It's not great – there's no file versioning, and the backup is manual and non-selective – but if you just want a sync drive with something basic for backup, it gets the job done pretty well.

Verdict

A good syncing service with a neat built-in backup solution.

★★★½



CLOUD DRIVE

$69.30/YEAR FOR ONE PC; $165/YEAR FOR UP TO 10 PCS
WWW.CODE42.COM/CRASHPLAN

CrashPlan

Makes backup a breeze.

CrashPlan is a solution that comes in two parts: the app and the cloud storage service. The app is free and useful, even if you're not a subscriber.

For the most part, it comes across as a conventional and comprehensive backup program. You check the boxes next to the files and folders you'd like to back up, then set your schedule and backup options.

It's in the backup destination that CrashPlan differs from the rest. In addition to the usual types of targets (USB drives, directories, network shares – CrashPlan has several unique options. One of those is to back up to another PC running CrashPlan, either yours or somebody else's. That way you can create your own peer-to-peer backup cloud, backing up your and your friends' PCs to each other (backups are encrypted, too).

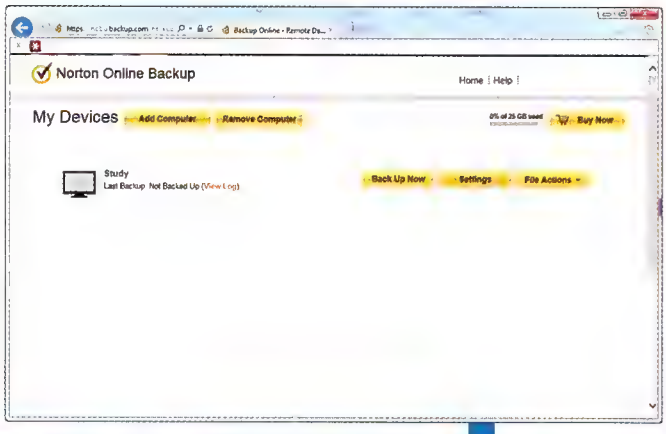
The other option is to back up to Code42's cloud servers, which is where the paid service comes in. The CrashPlan subscription provides unlimited capacity for one (on the Individual plan) or two to 10 (Family Plan) PC backups. It also includes a continuous backup option and unlimited file version retention, as well as a courier service where a physical drive can be delivered with your backup on it. What's more, Code42 is one of the few providers to have local Australian backup servers, which managed to redline our 30Mbps Telstra connection when we tested the service.

The weakness is on the mobile side. The mobile app lets you access files in your archives, but it's pretty basic and offers no backup of the data on your phone.

Verdict

Incredibly flexible, extremely fast and with a very fair pricing structure.

★★★★★



CLOUD DRIVE

$79.95/YEAR FOR UP TO FIVE PCS | AU.NORTON.COM/ONLINE-BACKUP

Norton Online Backup

Simple conventional backup.

In contrast to the hybrid approach of SpiderOak and Bitcasa or the flexible approach of CrashPlan, Norton's online backup service is conventional, following the likes of Carbonite, Backblaze and Mozy as a simple, straightforward backup solution. There's no syncing or multiple target support here – just a versioned, easy-to-use application to keep your data safe. This is the very same service that's built into (and can be managed from) Norton 360.

The application is managed entirely through a web browser, with only a small taskbar agent running on the host PC. For most users, the heavy lifting is already done – by default it's configured to back up important documents (based on file type) stored in your user folder, but you can add additional files and folders if you like. You can recover files through the same interface (versions are stored for up to 90 days), and you can also generate web links to individual files in the archive to email to yourself or other people.

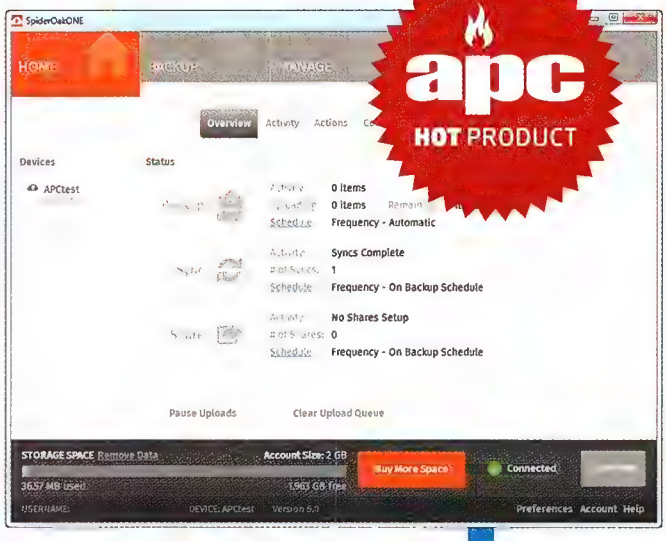
The backup service is a little limited. For example, you can't configure continuous backups and there's no Windows Explorer integration for easily adding additional folders. There's little to no mobile support either.

Still, it's a very easy solution for up to five PCs in the home. You just need to install the agent, register your PCs one by one and Symantec really takes care of most of the rest. If you just want something super-simple for a family of PCs, it's a decent bet.

Verdict

It's a service with limited options, but it's a good install-and-forget solution for families.

★★★½☆



apc HOT PRODUCT

CLOUD DRIVE

1TB, US$12/YEAR | WWW.SPIDEROAK.COM

SpiderOak

Strong backup capabilities.

Much like Bitcasa and a number of the newer cloud solutions, SpiderOak is something of a hybrid, offering both syncing services and backup. Compared to Bitcasa, though, SpiderOak has a much stronger backup pedigree.

The main portion of the SpiderOak application is the backup solution, which operates very much like a conventional backup app. You choose your directories from a tree and set your backup options, which includes useful features like bandwidth limiting and continuous or scheduled backup (if you have limited quota, switching from the default continuous is a good idea). By default, SpiderOak will keep multiple historical versions of a file. Once you've selected, you can just leave it to run.

The other part of SpiderOak is Hive, which is a syncing solution with features comparable to Dropbox. It's a little more awkwardly implemented than Dropbox, especially when it comes to linking and sharing with other users, but it's full-featured and is more flexible than Dropbox, Google Drive and OneDrive. It allows you to sync any folders and create ad hoc sharing groups using a ShareID.

The main SpiderOakOne control app for Windows has certainly grown on us, with easy-to-manage access to all of the service's main features. We particularly love the Windows Explorer integration, which lets you use right-click to add any folder to the sync or backup schedule. You can also set up the app on several PCs – SpiderOak only cares about total capacity, not the number of devices.

Verdict

An excellent hybrid solution, excelling at both backup and sync.

★★★★½

Build a low-cost Windows 10 PC

Zak Storey shows how to create a DirectX 12-ready rig for under $1,200.

Windows 10. Ah, glorious Windows 10. You come bearing many gifts of silicon-enhancing joy. DirectX 12 and a reimagined Start menu, you beautiful things. Sorry, we've been a little bit distracted of late, beta-testing Microsoft's latest platform. It's everything Windows 8 should have been. Still, no point crying over corrupt files. We've moved on. And what's important about Windows 10, more so than any of the tinkering that Microsoft has done with the operating system, is the inclusion of DirectX 12. Surely you've heard us rant about the new graphics API by now?

To put it bluntly, think of DirectX 12 as a free graphics card upgrade for everyone. But instead of going from a GTX 660 to a 670, it's more along the lines of a GTX 660 to a 970. Depending on whether you believe Microsoft's engineers, that is. But judging by the early results from the overhead API tests (something you really need to witness with your own eyes), it certainly looks promising.

Anyway, all this discussion about DirectX 12 and Windows 10 caused a bit of a row in the office, ending up with a challenge being issued.

Assemble a Windows 10 WQHD gaming-ready rig. Easy, you say? Well yes, very. If it's wasn't for the budget. A whole $1,200. So here we are, with an AMD CPU... just kidding! Sort of. Read on to discover what parts we picked and why, plus how we put them all together.

INGREDIENTS

PART		PRICE
CPU	AMD FX-8320	$215
CPU COOLER	COOLER MASTER HYPER 212 EVO	$45
MOTHERBOARD	MSI 970 GAMING ATX AM3+	$150
MEMORY	KINGSTON HYPERX SAVAGE 8GB (2X 4GB) 1,600MHZ	$90
OS STORAGE	KINGSTON SSDNOW V300 SERIES 120GB 2.5-INCH SSD	$75
AD STORAGE	WESTERN DIGITAL CAVIAR BLUE 1TB 7,200RPM HDD	$75
GPU	MSI RADEON R9 380 2GB GPU	$350
CASE	BITFENIX NEOS BLACK/RED MID-TOWER ATX	$70
PSU	EVGA 600B 600W PSU (BRONZE)	$95
TOTAL		**$1,165**

BitFenix Neos Black/Red

CASE

$70 | BITFENIX.COM

With a budget of just $1,150, it's inevitable that your spec is going to take a hit somewhere. More often than not, this will be in the chassis department. However, for us, the choice was obvious. BitFenix does some fantastic, good-looking and value-oriented case options. And the BitFenix Neos comes in at $70, which happily puts us well within our target budget.

This cheap and cheerful chassis is a small, lightweight and stylish ATX mid-tower. Ideal for our build, it also includes some very intuitive features that you wouldn't expect to find on a case with this low a price point, such as 2.5-inch and 3.5-inch removable drive bays, the latter of which are toolless. Additionally, if you fancy chipping in a little extra, you can drop another $10 into the windowed edition, which nets you a red LED BitFenix Spectre fan as well.

PSU

$95 | AU.EVGA.COM

EVGA 600B Bronze

The power supply will always be one of the trickiest components to choose when it comes to building a budget-oriented rig. The biggest challenge is finding out how much wattage your lovely new PC is going to utilise, and then accommodating for that. Your best bet is to use a calculator. You'll find a fantastic integrated PSU calculator at the top of your selected part's list at au.pcpartpicker.com.

Ideally, the PSU is one of the components into which you should invest as much as you can. In short, if you buy too cheap a power supply and it pops, it could easily take one or all of your components with it. Because of this and our tight budget, we opted for an EVGA 600B Bronze. Unfortunately, it's non-modular, but it does give us 600W of power and a bronze efficiency rating, which should be more than enough for our AMD build.

CPU

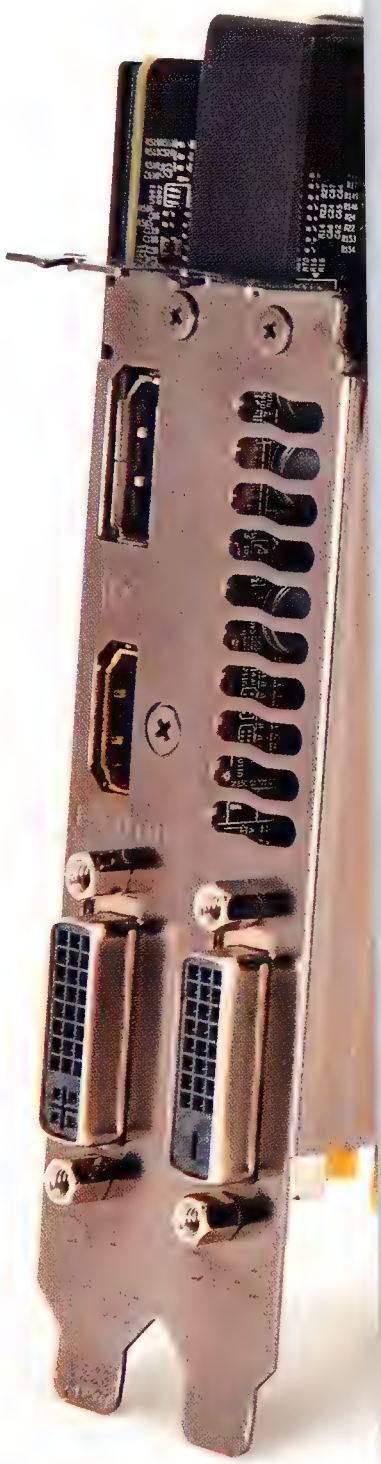
$215 | AMD.COM

AMD FX-8320

Historically, AMD has been the go-to company for budget builds and cheap gaming CPUs. Recently, however, AMD has pushed more time and effort into developing its Kaveri line. Although it boasts impressive integrated graphics in comparison to the competition, Kaveri lacks a great deal of computational power, allowing Intel to dominate the solutions. That being said, you can still build yourself a solid, low-cost AMD gaming machine, as long as you're willing to give up native USB 3.0, PCIe Generation 3 and additional SATA 6Gbps functionality for the sake of your budget.

For this build, we settled on an FX-8320. Despite being an aging processor, this little beauty's eight cores should be more than enough to drive the latest games at 1080p and beyond. And if DirectX 12's multicore-loving features are anything to go by, this CPU should be able to pump out some impressive benchmarks later on in its lifetime. The chip comes in at $215, featuring eight cores, 3.2GHz of processing power (turboing up to 4GHz) and support for DDR3 memory up to 2,400MHz on the AM3+ socket. While it's not the tsunami of rendering power that you'd find on an Intel chip, the CPU performs admirably for everyday computational tasks.

The alternative solution by Intel would've been the Core i5-4460. Its four cores provide very similar performance, but it isn't overclockable, meaning you won't be able to increase those numbers anytime soon. Despite this, it does provide PCIe 3.0, more SATA 6Gbps ports and native USB 3.0 support, giving it the slight edge when it comes to feature sets.



GPU

$350 | AU.MSI.COM

MSI R9 380 Gaming

For driving graphics, we couldn't think of a better option than to stick with AMD, as its GPUs offer the best bang for your buck. The driver updates are less frequent and the software package isn't as strong as Nvidia's, but what truly matters here is horsepower. Dollar for dollar, this card won't let you down. If you're looking to hammer the frame rates at 1080p, there's no better call.

Featuring a repackaged Hawaii core – the same found in the R9 290 and 390X – plus five billion transistors and 4GB of GDDR5, this card should perform well. Coming in at $350, MSI's R9 380 Gaming is a fantastic choice. Taiwanese manufacturer MSI is well-known for its military-grade products, and the Twin Frozr aftermarket cooler is one of the best. Chilled, silent and sexy, even the colour scheme matches the classic black and red that's synonymous with gaming. Not so much Windows 10, but we digress...

The alternative by way of Nvidia's offering would be a GeForce GTX 960. Specifically, ASUS's GTX 960 STRIX 2GB card. This edition is a bit smaller than our 380, but it performs just as well in games. It just doesn't match that colour scheme quite so well.

RAM

$90 | KINGSTON.COM

Kingston HyperX Savage 8GB

For memory selection, it was a bit of a no-brainer. We went for the default choice: 8GB (two 4GB sticks) of DDR3 at 1,600MHz. Pushing money into frequency here certainly wouldn't help us get any more performance out of the graphics card. And although that extra frequency may help when it comes to higher-end computational tasks, it's simply not worth dropping the additional coin into it at the moment, as we're not intending to use this PC as a professional workstation anyway.

Kingston's HyperX Savage RAM matched our build perfectly. It fit the black and red colour scheme and came in at a competitive price for the kit, slotting itself perfectly into our meagre budget.

CPU COOLER

$45 | COOLERMASTER.COM

Cooler Master Hyper 212 EVO

Let's be realistic here. The FX-8320 isn't a super-fast CPU, certainly not at stock. So, if we can overclock it, we will. And quite frankly, even at stock, the retail cooler that AMD ships with the eight-core processor just doesn't cope very well with that heat. So, with what little budget we had left, we decided to invest in a CPU heatsink worthy of our time.

Ladies and gents, we give you the Cooler Master Hyper 212 EVO. It's not the best-looking heatsink out there. And it's not the most intuitive to put together. But is it solid and dependable? Yes. Will it keep your beans on ice? Well, probably not. But if you're looking for room temperature, it'll do just fine.

MOTHERBOARD

$150 | AU.MSI.COM

MSI 970 Gaming

The motherboard, the backbone of the system. After opting for the FX-8320, we had to find ourselves a suitable solution to house all that power. Sadly, finding new motherboards in AMD's lineup is quite the challenge. It's certainly less simple than with Intel, where each new chip denotes a new chipset.

The MSI 970 Gaming is a fantastic entry-level gaming motherboard. Featuring support for CrossFire and SLI, as well as DDR3 up to 2,133MHz, and a plethora of SATA connectors (at least, for an AMD board), there's no better choice. Also, guess what? Black and red.

STORAGE

$75 | KINGSTON.COM

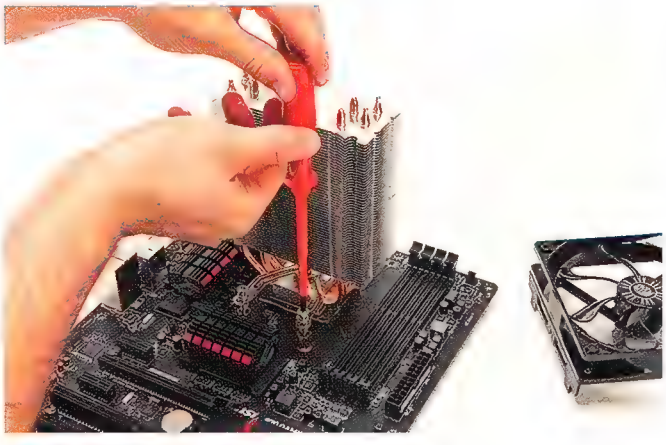
Kingston SSDNow V3 120GB

You shouldn't even bother calling yourself a PC enthusiast today if you're not using an SSD for your operating system. The price of flash storage has dropped astronomically over the last couple of years, to the point where you can buy yourself a 120GB Kingston SSDNow V3 for $75. Granted, it'll run a little slower than some of the more premium options out there, but it's a damn sight faster than any hard drive, that's for sure.

For additional storage, we threw in a 1TB Western Digital 7,200rpm hard drive ($75). This will provide you with plenty of space for all of your games and any additional files you might need to store on your budget build.

Time to get building

A step-by-step guide to putting your Windows 10 PC together.



1 PREPPING FOR YOUR BUILD

It'll probably come as no surprise, but the best way to build a rig is to plan it well. The first and most crucial aspect of creating your new PC is setting up your build area. Make sure that wherever you decide to construct your machine, the area is free from distraction. Ensure you've got all the tools you'll need to put your beasty together (usually a Phillips-head screwdriver, some scissors and a set of needle-nose pliers for the fiddly bits). And last but not least, try to find a static-free area – avoiding woolly socks and carpets is usually best.

If you're paranoid, you can buy an anti-static strap. However, if you can't find one or are feeling stingy, regularly touch the casing around a power supply that's plugged into the wall, but powered off. This will discharge all of the static electricity that you're potentially building up in your body, and may possibly save you some heartache later.

2 INSTALLING THE CPU AND HEATSINK

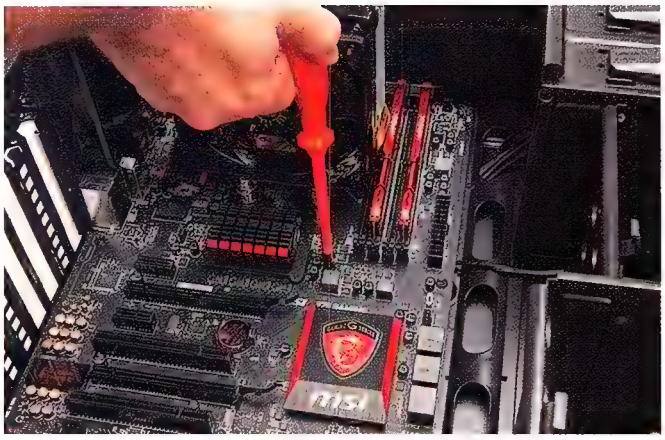
Start by building your PC outside of the case. If any components are dead, it makes it much easier to diagnose and disassemble. The motherboard box also acts as a great anti-static test bench. Start with the CPU. Lift the retention arm on the CPU socket on the motherboard, align the FX-8320 with the socket (the golden triangle on one corner of the CPU will match up with the same triangle on the socket). Next, drop it into place, lower the arm back down and lock it in.

Now, the heatsink. Secure the backplate with the nut and bolts. Add a dollop of thermal paste to the middle of the CPU, then carefully position and screw down the heatsink, ensuring that the intake of the fan is facing towards the base of the case. Screw the heatsink down in a cross pattern (ie. diagonally), to ensure you don't put excess pressure on one side of the CPU, potentially bending the pins. Then it's just a case of looping your CPU fan cable around and plugging it into the CPU fan header located above.

3 INSTALLING THE RAM AND GPU

Next is the memory. Lift the tabs on either side of the DIMM slots, then line up the RAM, matching the gap in the stick to the notch in the motherboard. Push them securely into place. Once you hear a satisfying click, you'll know it's correctly seated. It doesn't overly matter which channels you use, but for max performance it's often best to place them one apart (usually colour co-ordinated). Also for this build, you'll want to place them as far away from the heatsink as possible, due to the size of the cooler, while still keeping them in the colour co-ordinated channels.

After this, the graphics card. Gently take your GPU out of its anti-static bag (don't place it on the outside of the bag, as it's conductive and will discharge all of the electricity it's collected). Remove the protective covers on the PCIe connector on the bottom of the card and gently slot it into the topmost PCIe slot. Usually, we'd advise you not to touch the PCB on the back of the card, but due to MSI's inclusion of a snazzy-looking backplate, there's no chance of potentially damaging it.



4 INSTALLING THE MOTHERBOARD

Once you're confident all your new gaming hardware is working, it's time to throw this bad boy into your chassis. First, pull the GPU out of your motherboard (simply move the clip located on the PCIe slot upwards). Next, unpack your case and remove all of the unnecessary components. This means two of the SSD trays can come out, plus two HDD trays and the little welcome pack of screws. After this, take the rear I/O shield out of your motherboard box and place it into the rear of your case (make sure it's oriented the right way around), and push it into the slot at the back of the chassis until it clicks into place all along the edges.

Next, align your motherboard with the preinstalled standoffs and screw it down. Remove the two corresponding PCIe slot covers on the back of the case and reinstall your GPU, before securing it with an extra two screws. You'll have to remove BitFenix's ingenious PCIe slot cover – just pull it out and click it back into place once you're done.

5 THE PSU AND CABLE MANAGEMENT

Next is the power supply. Remove the case's side panels and slide your PSU in the rear allocated slot. Make sure that the fan is facing down, so it can pull air from the underside of the case and exhaust it out the back. Push all of the cables through the space in the bottom of the case.

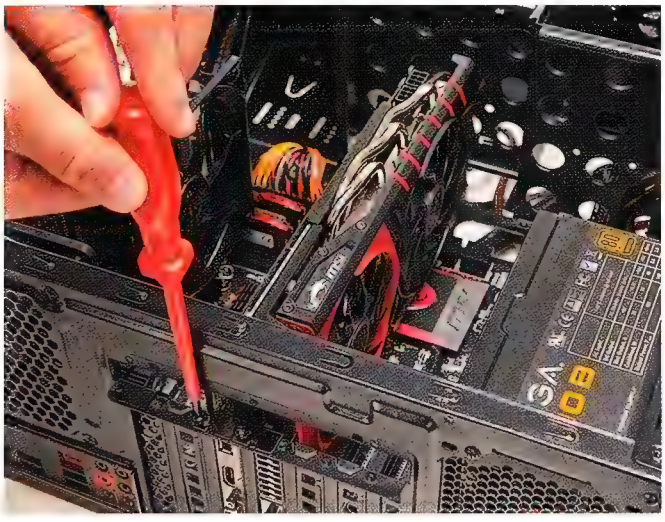
You'll want to plan which cables go where. The CPU's eight-phase power is hardest – pull it up through the uppermost hole. Run it along the top of the motherboard, around the RAM and into the CPU power. The 24-pin power for your motherboard can go in the cable-routing hole below the one you've just used for the CPU. Don't force anything, as you'll risk damaging the connector and power supply cable. Then route your front I/O cables around the back and down into the bottom-half of the chassis. Refer to the manual to connect your power/reset buttons and LEDs.

Leave three SATA connectors in the rear and the PCIe power cables in the front. Bundle the remaining cables together with ties and leave them in the bottom of your chassis.

6 INSTALLING THE SSD AND HDD

It's now time to install your hard drives. The BitFenix Neos comes with both 3.5-inch and 2.5-inch drive bays. To install SSDs, pull one of the 2.5-inch drive trays out. Place your SSD inside it (with the connectors facing away from the two finger grips), then secure the drive in place with four screws. Once it's snug, slide the drive back into the cage until it clicks. For the 3.5-inch hard drives, BitFenix has developed an innovative way to secure them. Simply take one of the drive caddies, pull it gently apart, slot the drive in place and push the caddy back together, again with the connectors facing away from the two finger grips.

Now run two SATA cables from the first two ports on the motherboard to your drives. Avoid the cable holes and run them past that panel, around the back of the chassis. Due to the positioning of the cut-out, you won't be able to run the cable through the hole. Then connect the two hard drives using the SATA power connector we left behind the case earlier.



7 INSTALLING THE GPU

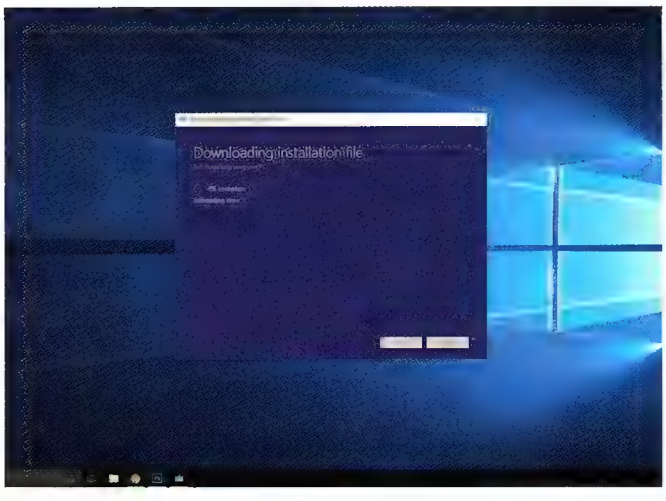
Next up, you'll want to reseat the GPU again. Simply line it up once more with the PCIe slot and press it firmly into place, without using too much force. Try not to bend the connector, or you'll end up snapping off the connector and ruining not only your GPU, but your motherboard, too.

Then run the two six-pin PCIe power connectors to the card, and install them like you did previously. Additionally, you could use a cable tie here to make sure the PCIe power is nice and cosy. It isn't entirely necessary to cable tie everything down, but it's always advisable to do it where you can, as it improves airflow and generally looks better. It's also a hell of a lot easier to see what you're doing if you need to make modifications in the future, or if you need to clean out your PC.

8 FRONT I/O CONNECTORS

Now for those pesky front I/O connectors. The cables should be positioned through the bottom of the chassis. Run the HD audio as far down as you can get it, then along the bottom of the motherboard and into the HD audio connector on the bottom-left of the motherboard.

Next, grab the USB 3.0 cable, and do a similar run. You'll find the USB 3.0 connector isn't located like it is on Intel boards – it's in the bottom-centre of the motherboard. The USB 2.0 cable can be plugged into the right of the USB 3.0 cable. And finally, the front power and reset switches. These aren't labelled on the motherboard, due to AMD's aging platform. Refer to the manual for the correct positioning of each pin. You can then secure the side panels back on to the chassis.



9 INSTALL WINDOWS 10

We've always found the best way to install Windows 10 is via a fresh install using a USB key. Get the ISO via your Microsoft account, then insert a USB key (8GB is the usual minimum) and use Microsoft's Media Creation Tool to create a bootable disk. A forewarning that the USB key will be formatted, so make sure any data on there is backed up.

Once you've created your bootable media disk, plug it into a USB 2.0 port at the back of your PC. (If you're running Intel, you should plug it into USB 3.0.) Then boot your PC and make your way to the BIOS. Find the USB key in the boot order lineup (top of your screen) and drag it to the far-left. Then hit 'F10 > 'Save settings' > Apply' and let your PC boot into Windows. Once you're in, you're going to want to jump onto another PC, laptop or phone, head to **tinyurl.com/pzxrvaz** and download the Windows 10 LAN drivers onto a USB stick. Install them on your rig, update the rest of your drivers, and voila, most of your work is done.

10 INSTALLING PROGRAMS

A quick and easy way to install a lot of commonly used programs is a website called Ninite. It's incredibly straightforward to use and it's something we use almost every day. Head to **www.ninite.com**, select which programs you want to install and select 'Get Installer'.

Ninite will then download its installer and automatically install those programs, ensuring you get the most up-to-date software available. Adware free, no hidden secrets. (It makes money from a B2B product, so don't worry!) Then it's just a case of installing some of your more bespoke favourite programs, and you're good to go!

1 The toolless 3.5-inch bays make it incredibly easy to install any additional hard drives you might have, allowing for a total of three.

2 BitFenix even includes 5.25-inch toolless bays. If you really do need an optical drive, you could throw one in here with relative ease.

3 A modular power supply would have been nice here, but the EVGA 600B is brilliant value and comes with a great warranty.

4 The Neos also has support for two 120mm fans in the front of the chassis, which is ideal for such a hot system like this one.

Game on

If you've come this far, you'll have one hell of a rig. For price to performance, it's not going to get much better than this – it'll wipe the floor with consoles at entry level. You're already playing games way above 30fps at 1080p, and if you turn down some of the anti-aliasing, or the more intensive effects, it's viable to game at 1440p and comfortably hit the 40-50fps mark. It's a little different at 4K, of course, but then you're pushing twice as many pixels – both the CPU and the GPU bottleneck the system at this point.

Building inside of the BitFenix was surprisingly simple. Although it does lack some mod cons, for $70 it's an impressive chassis. Yes, it's a little flimsy and the panels require some love, but is it stylish? Yes. Is it easy to build in? Well, yes. There weren't any major setbacks, other than possibly the lack of upper cable-routing holes. However, fan support is very limited, but the fact that it comes with SSD support and toolless 5.25-inch and 3.5-inch drive cages is incredible at this price.

THE ALTERNATIVE?

Intel remains a viable solution. For just another $20, giving a total budget of $1,185, we ditched the CPU cooler and switched in a Core i5-4460 CPU, an ASUS H81 Gamer ATX LGA1150 motherboard, an ASUS GTX 960 2GB GPU and dropped the PSU by 100W.

You pay the Intel premium, but you're only losing out on a CPU cooler and 100W of power that you're not going to need. Considering you won't be overclocking a Core i5-4460 anytime soon, this shouldn't be a worry. And the fact that you're using less energy to run your little monster, the cost difference should even out over its life.

WHERE TO INVEST?

While working on this budget gaming build, BitFenix offered us the windowed edition of this chassis. However, adding even an extra $10 wasn't viable for our budget. That being said, this build is colour co-ordinated, and MSI has made one hell of a good-looking GPU. We'd struggle not to suggest buying the windowed edition instead.

Unfortunately, this case can get incredibly warm. So much so that on occasion, it feels like you're contributing to global warming. The GPU in particular, especially when overclocked, gets quite toasty at around 80°C. That's quite hot for any aftermarket cooler. This is in no way MSI's fault. It's more because we overclocked the hell out of it and there aren't any air intake fans by default on this chassis. So that would be our final suggestion. If you've a few extra dollars, throw in a nice set of fans, a windowed-edition chassis, and possibly a Corsair Hydro H60 SE, or something along those lines, just to keep the CPU temperatures down. ■

SYSTEM BENCHMARKS

	AMD FEATURE BUILD	APC LABS GAMING PC
CINEBENCH R15 (INDEX)	507	601
PCMARK 8 (INDEX)	2,665	3,998

THE APC LABS GAMING PC HAS A CORE I5-4690K, 16GB DDR3 AT 1,600MHZ AND A GTX 970.

GAMING BENCHMARKS

3DMARK FIRESTRIKE (INDEX @1080P)	7,047
BIOSHOCK INFINITE (@1080P)	9/97
PROJECT CARS (@1080P)	35/46
METRO: LAST LIGHT (@1080P)	12/38
TOTAL WAR: ATTILA (@1080P	6/23
SHADOW OF MORDOR (@1080P)	7/34
3DMARK FIRESTRIKE (INDEX @1440P)	3,943
BIOSHOCK INFINITE (@1440P)	7/71
PROJECT CARS (@1440P)	32/39
METRO: LAST LIGHT (@1440P)	12/23
TOTAL WAR: ATTILA (@1440P)	1/24
SHADOW OF MORDOR (@1440P)	7/25

ALL GAMES TESTED AT MAX SETTINGS WITH 4X ANTI-ALIASING. GPU OVERCLOCKED TO 10% LOWER THAN COMMUNITY MAX. GAME SCORES ARE MINIMUM FRAME RATE, FOLLOWED BY AVERAGE FRAME RATE.

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

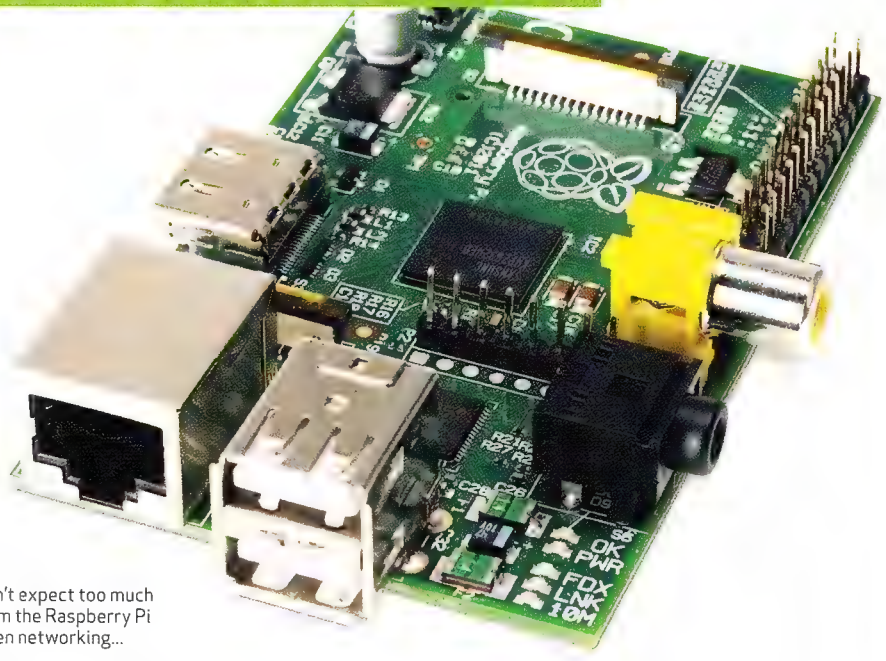
RASPBERRY PI
USING THE PI AS VPN

I recently upgraded my home broadband to fibre and it's a huge improvement for both streaming media and ordinary web browsing. My desktop PC, laptop and iPad are all very thankful! However, it hasn't seemed to make any difference to my Raspberry Pi (Model B). I'm trying to use it to create a personal VPN for secure browsing, but I'm only seeing a maximum of 1Mbps upload and barely more for downloading. This is pathetic and it doesn't seem to make any difference whether I connect via Wi-Fi or Ethernet. Is there anything I can do to boost the speed?
Mark Seisemore

Probably not a great deal. The network hardware on the Raspberry Pi is connected to the USB controller, so the CPU has to process each byte that's received or transmitted. This is quite different from the network interface controllers on a full PC, which have their own chips to handle the lower layers of the network protocol and don't involve the CPU until the packets have been reassembled. I've seen some Raspberry Pi implementations that can manage as much as 5Mbps downloading and 2Mbps up, but these were very stripped-down apps doing not much more than measuring the speed of the connection. You have to remember that a Model B Raspberry Pi is by design just about the simplest PC you can have. For a VPN, even a really old laptop or desktop will give you much better performance. Not only do most have dedicated Gigabit-speed network hardware, but their CPUs are much faster as well.
Luis Villazon

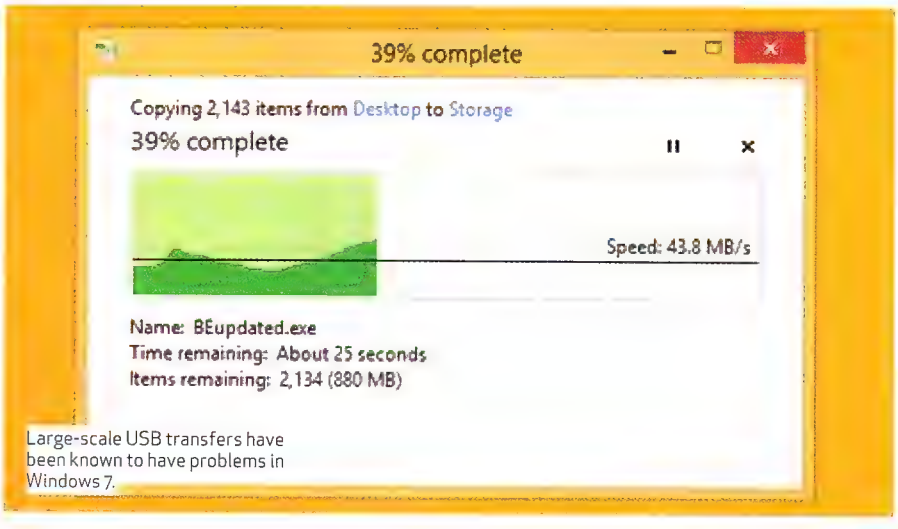
HARDWARE
IS MY HARD DISK DYING?

I'm trying to be a good boy and back up my files, like you are always telling us to, but I'm running into a problem. I'm using an external Western Digital 2TB drive and if I copy files across one at a time, it all works fine. But when I copy them over in bunches (a whole directory at a time, say), some of my files are corrupted with garbage. Sometimes they will open but show weird characters at the end. Others just refuse to open at all. I have checked for viruses and it isn't that. Does this mean that the drive is faulty?
Keith Jekes



Don't expect too much from the Raspberry Pi when networking...

Are you still running Windows 7? There have been reports of data corruptions with large-scale USB transfers for years, but I've yet to see one under Windows 8. This is most likely a problem with the USB interface. I suspect that when big transfers are buffered, certain circumstances can cause the buffer to be overwritten. This could be a buffer in system RAM, but it could also be on the drive itself. I've also heard people insist that taking the USB cable out and breathing on it helps by increasing the conductivity with the moisture from your breath. But none of them were sober. This isn't a hardware problem; it's a software one. A program is allowing the transfer buffer to be corrupted. X-Fast USB,



Large-scale USB transfers have been known to have problems in Windows 7.

If your fans suddenly go haywire, it's time to reset the SMC.

which is bundled on some ASRock motherboards, is an example of this. It seems to speed up USB transfers by creating a layer of buffering in RAM, and disabling this has eliminated copy corruption on some systems. Now, let's turn our attention to your backup strategy. Manually copying files 'in bunches' is better than nothing, but not much. Instead, clone the entire partition using something like Macrium Reflect (**www.macrium.com**) or Acronis True Image (**www.acronis.com**). This doesn't rely on deciding whether a file is important or not (pro tip: they all are) and has the side benefit that byte-for-byte cloning utilities will normally bypass a lot of the possible sources of corruption that can affect file-based copies.
Luis Villazon

MAC
WHY DOES MY MACBOOK OVERHEAT?

My 2007 MacBook Pro seems to abruptly overheat, even when I'm not doing anything intensive. I can be watching a video for a couple of hours with the fans whirring silently and then, after I quit, the fans will spring into life and blast away at full speed, staying at this level until I shut down. Other times, my MacBook runs the fans at full speed even from startup... Help!
Brian Halliday

If the air coming out of the vent feels cool, this might be a problem with the fan regulator rather than overheating. If your Mac isn't running hot during video playback then it isn't likely to suddenly heat up just because you've closed the video. OS X doesn't run the fan slower than it needs to. However, it is common for fans to get stuck at maximum speed; it's nearly always fixed by resetting the System Management Controller (SMC). On the 2007 MacBook Pro, which has a removable battery, the procedure is to shut down the Mac, disconnect the MagSafe connector, take out the battery and hold the power button down for five seconds. Then put the battery and MagSafe connector back in and restart.
Luis Villazon

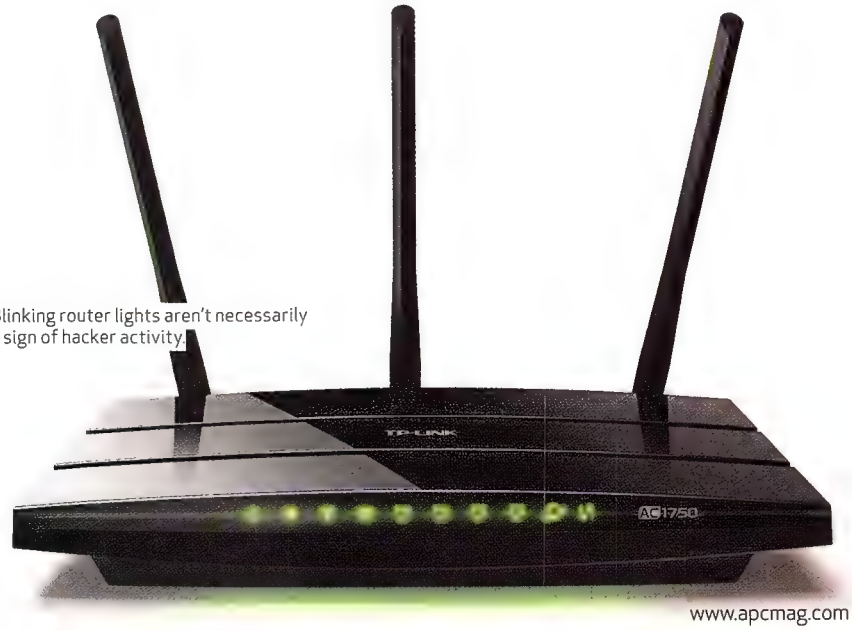
NETWORKING
THOSE BLINKING HACKERS

How can I tell if someone is hacking into my Wi-Fi? I have a new router (recently replaced when we upgraded to fibre broadband) and I have seen some suspicious activity. The Wi-Fi light blinks when none of our PCs are on, for example. If I look at the DHCP list on the advanced page, it shows some computers that I don't recognise. Should I be worried?
Austin Blake

Probably not, but this level of caution is sensible. Check you are using WPA or WPA2 security on the 'Wireless Summary' page. WEP is the Wi-Fi equivalent of the lock on the bathroom door: it won't keep out anyone that doesn't respect your privacy already. The default for most routers these days is WPA/WPA2 mixed mode, which provides decent security and still allows older devices to connect. If you're already using this, change the password to be doubly sure, but we're pretty sure you're fine.

Of course, even completely open Wi-Fi isn't necessarily a cause for concern. Otherwise, how would cafes and shops be able to offer it? Letting someone on your Wi-Fi only guarantees them access to your internet connection and your local area network. It doesn't let them onto any of your actual computers unless you have enabled guest accounts, have easy-to-guess passwords, or are running unpatched versions of Windows with security vulnerabilities.

Probably the easiest way for a hacker to get into your system is to access the router configuration page and change the DNS records so that **google.com.au** actually points to a webpage of their choosing that downloads a Trojan to your desktop. That's why it's at least as important to change the admin password on your router as it is to change the Wi-Fi password. Leaving it as 'admin' is asking for trouble.
Luis Villazon



Blinking router lights aren't necessarily a sign of hacker activity.

Create an Excel log file

Helen Bradley explains how to monitor work done on a file using a macro.

When you want to track the work on a file, and you can write a macro to automate the process.

This month's macro writes data to a log file to record the file being opened and closed, and it stores information about the work that's been done to it. You can download the macro code from **www.apcmag.com/magstuff**.

CREATE THE FORM

The macro must be stored in the file it relates to, so first open the Excel file and save it as an Excel Macro-Enabled workbook (*.xlsm) file. First go to 'Developer > Visual Basic' followed by 'Insert > UserForm'. Add a Listbox, a frame containing two or more OptionButtons, a Label as well as a CommandButton.

Set the MultiSelect property of the ListBox to 1–fmMultiSelectMulti to allow the user to choose multiple items from the list. Set the Caption property for each OptionButton to a user's initials, then set one OptionButton's Value property to True, set the CommandButton caption to 'Write Data' and the UserForm caption to 'Work done on file'. The Label caption will be 'user instructions'.

Double-click the CommandButton and add this code to the form:

```
  Public logData As String
  Private Sub UserForm_
Initialize()
  With ListBox1
      .AddItem "Data Entry"
      .AddItem "Data Query"
      .AddItem "Print Daily
Report"
      .AddItem "Analyze
Results"
      .AddItem "Annual Report"
  End With
  End Sub

  Private Sub CommandButton1_
Click()
  spacerTxt = ""
  For i = 0 To ListBox1.
ListCount - 1
      If ListBox1.Selected(i) =
True Then
          logData = logData +
spacerTxt + ListBox1.List(i)
          spacerTxt = ", "
      End If
  Next i
  For Each cntrl In Frame1.
Controls
      If cntrl.Value = True
Then
          logData = logData + "
:" + cntrl.Caption
      End If
  Next
  Unload Me
  End Sub

  Private Sub UserForm_
Terminate()
  Open CreateObject("WScript.
Shell").
SpecialFolders("MyDocuments")
& "\worklogfile.txt" For
Append As #1
  Write #1, Format(Now(),
"hh:mm  dd-mmm-yyyy : ") &
logData
      Close #1
  End Sub
```

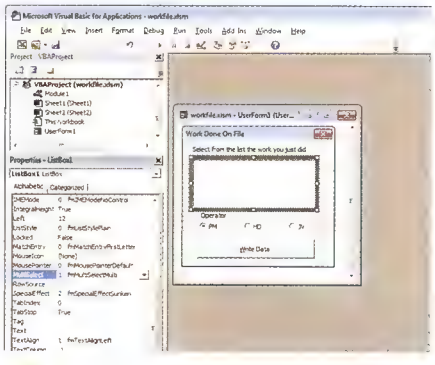
CREATE THE CODE

Choose 'Insert > Module' and type the following procedures:

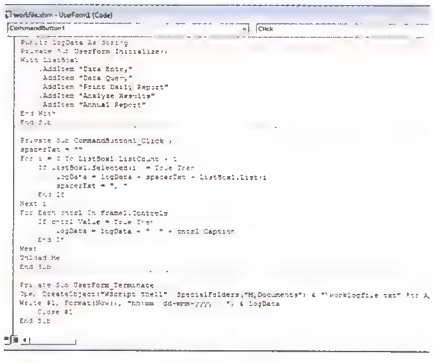
```
  Sub auto_close()
      UserForm1.Show
  End Sub

  Sub auto_open()
  Open CreateObject("WScript.
Shell").
SpecialFolders("MyDocuments")
& "\worklogfile.txt" For
Append As #1
  Write #1, "-------------"
  Write #1, Format(Now(),
"hh:mm  dd-mmm-yyyy : ") &
"Opened"
      Close #1
  End Sub
```

The Auto_Open macro will run automatically when the file is opened. It opens worklogfile.txt from the user's 'My Documents' folder. If the file doesn't exist, it is created. The macro writes a separator line to the file followed by the current time and date, along with the word Opened to record the Excel file being opened. The text file is then closed.

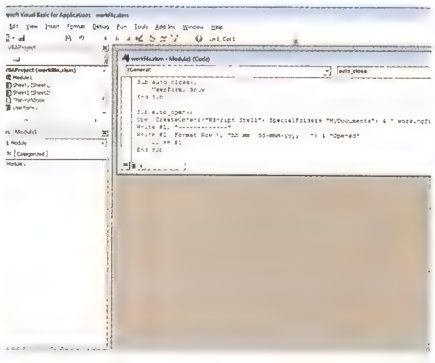
On closing the file, the Auto_Close macro is triggered and it loads the UserForm. The ListBox is populated with items which the user then selects to indicate the work done on the file. The selected entries are added to a variable with the Caption from the selected OptionButton. The text file is opened, the data from the variable together with the date and time is written to it, and then it is closed.



1 STEP 1
This is the user form that appears when the file is closed.



2 STEP 2
This is the code for the UserForm – it appears when the file is closed.



3 STEP 3
This is the code for the module. It contains macros that run automatically when the file is opened and closed.

disc contents

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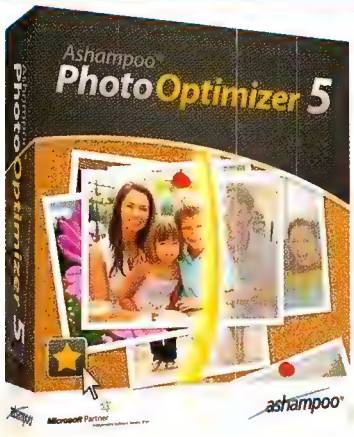

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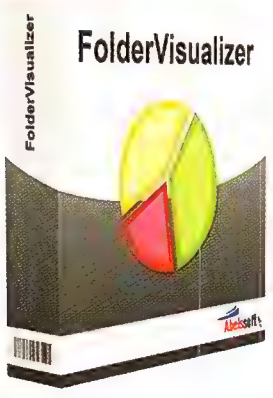
DOWNLOAD LINK: WWW.ASHAMPOO.COM/LPA/APC



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FolderVisualizer finds wasteful files and space intensive programs in seconds. This tool analyses your hard disks and shows you which files and folders occupy most of your space. For some files and file types, additional information helps you decide whether to keep or discard a file. Folder Visualizer can also analyse internal and external disk drives including USB sticks.

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SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The *APC* disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the *APC* disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the *APC* disc have different system requirements. Software is included on the disc for Windows Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the *APC* disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the *APC* disc, please visit **www.apcmag.com/disc.htm**.
- *APC* provides no technical support for this disc or any software provided on it.

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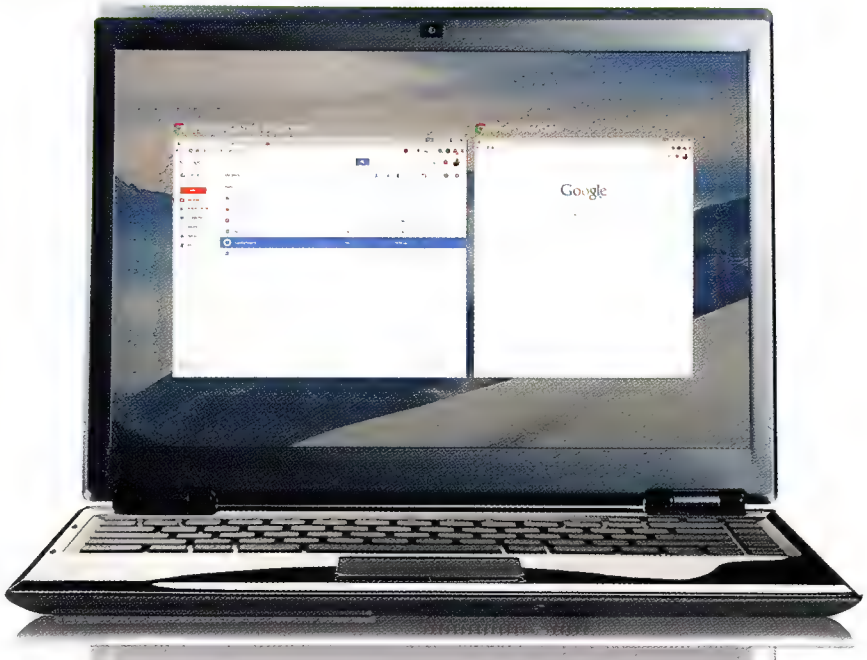
Use virtual desktops in Windows 10

Using multiple virtual desktops is a fantastic way of organising work into separate manageable areas, each specific to the way you use your PC. Zak Storey shows you how.



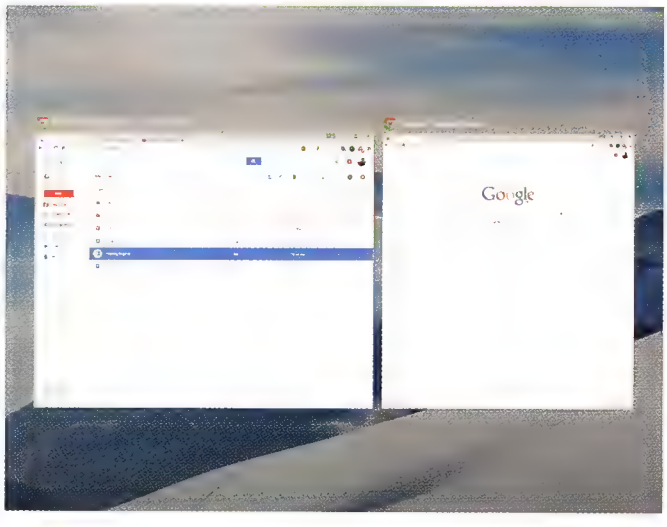
The ability to have (and swap between) multiple desktops is a feature that has long been missing from Windows. If you use your PC for gaming, but also for office work, for example, it can be indispensable and less confusing to have an individual desktop for each.

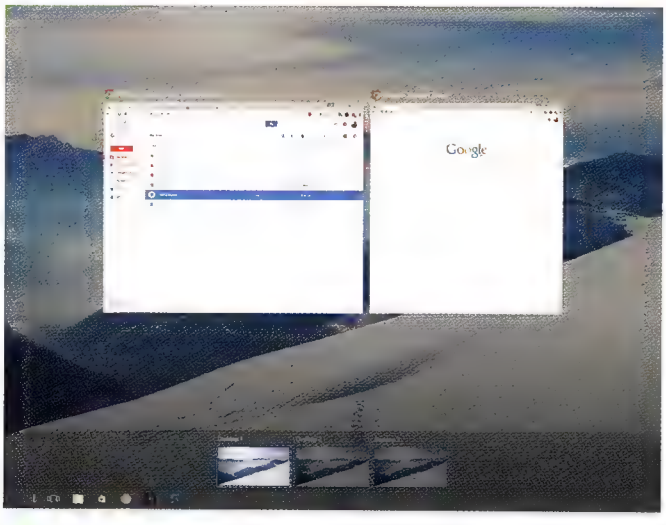
In this tutorial, we'll walk you through Microsoft Virtual Desktops – a feature that is new to Windows 10. This not only gives you more desktop space for separate task-related windows, but it also allows you to quickly and easily access what you need, so you're ready to go.

What's more, because you're not creating a virtual machine, you won't be take up any precious system resources or space with your additional desktops. Let's get going!

Adding virtual desktops

Manage your desktops for different tasks.



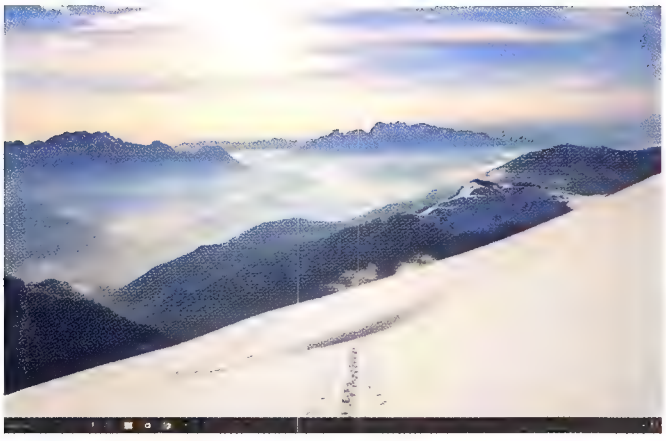


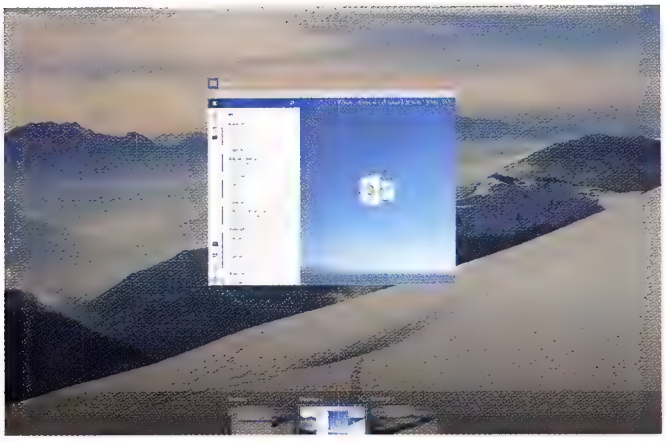
1 OPENING YOUR TASK VIEW

The 'Task View' button sits to the right-hand side of Cortana's search menu. To get going with Virtual Desktops, click the 'Task View' button and it will open up the multi-app view. In this view, you can see every application and window you currently have active on your main desktop

2 ADDING A NEW DESKTOP

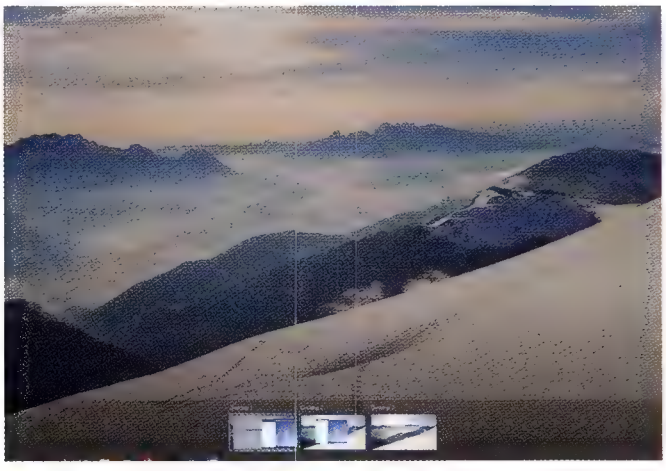
Adding a new desktop is straightforward. Move your cursor to the bottom right-hand corner and left-click 'New Desktop'. Here you can add as many desktops as you need. Once you've added these, they will act as separate hubs for you to place your open applications into.





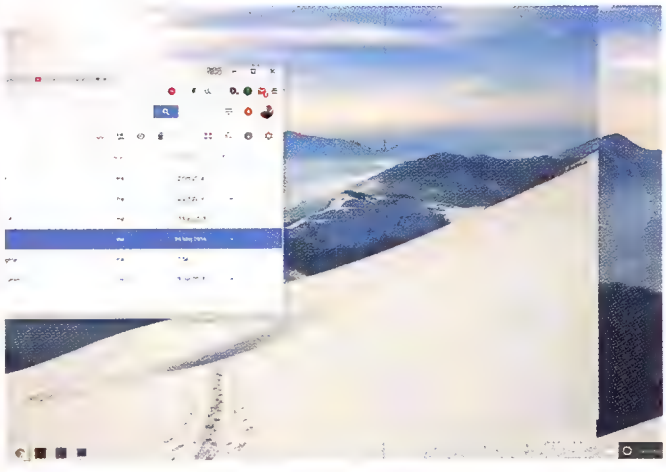
3 ORGANISE MAIN DESKTOP AND ADD APPLICATIONS

Unfortunately, you can't assign shortcuts and files to particular Virtual Desktops. In fact, the shortcuts or files you place on the first desktop will appear on all desktops. With that in mind, you should keep your main desktop as clean as possible, by removing or moving applications or files you don't use.



4 SEEING WHAT'S OPEN ON EACH DESKTOP

If you want to know what's open on what desktop, open 'Task View' again by clicking the button to the right of the Start menu. Now hover over each of the desktop tabs at the bottom of the screen. Windows will then display in its main window which applications are open on each desktop.

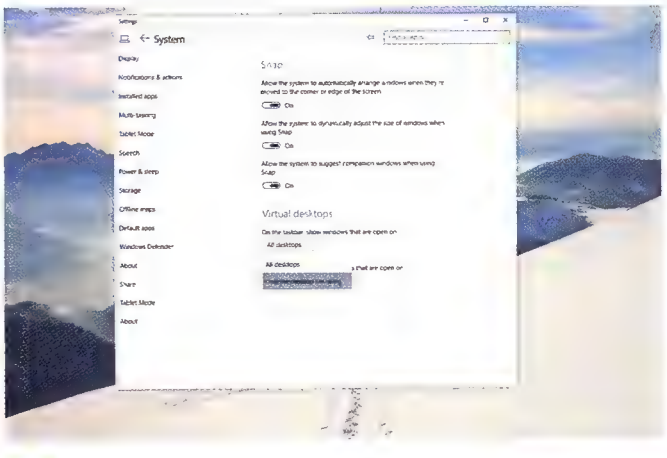


5 MOVE OPEN APPS BETWEEN DESKTOPS

There's a straightforward way to quickly move one application from one desktop to another. Just go to 'Task View' again, then simply left-click and hold the open window or application you want to move, and you can drag it to the destination desktop.

6 SOME USEFUL SHORTCUTS

There are many shortcuts you can use with Virtual Desktops. To switch to the previous or next desktop, press the Windows key with Ctrl and the left or right arrow keys. To close the desktop press the Windows key with Ctrl-F4. To jump into the Task View press the Windows key with the Tab key.



7 SHOW ALL OPEN APPS IN TASK BAR

You can enable your task bar to show all the programs that are open on all the desktops, so that it, in effect, acts as a hub. Simply type `Virtual Desktop` into the Start menu, open the settings and change the first drop-down menu to say 'All Desktops'.

8 SEE OPEN APPS FROM ONE DESKTOP

Pressing Alt-Tab is a quick way to see all open apps across multiple virtual desktops. However, if you only want to see programs on the current Virtual Desktop, go to the Virtual Desktop settings again, and select the 'Only the desktop I'm using' option from the Alt-Tab drop-down menu.

Configure the OS X application firewall

With the number of malicious attacks on Macs increasing, Matthew JC. Powell shows you how to build a wall against them.

If you watch a lot of Hollywood movies, you're probably familiar with the term 'firewall' as some sort of defence mechanism against computer-based attacks. Of course, since no screenwriter in Hollywood actually seems to know what a firewall is or what it does, that may well be the extent of your understanding of it.

A firewall is just a program that monitors traffic coming in and out of your computer. If you wish, you can instruct the firewall to allow certain traffic through and to deny access to other traffic. And that is basically it – there's no actual fire involved.

Until fairly recently, Mac users have been able to be fairly blasé about understanding and using things like firewalls and antivirus software because the number of malicious attacks on Macs has been vanishingly small. It's still vanishingly small as a proportion of the overall malware picture, but it's significant enough now that you should arm yourself with a bit of basic knowledge.

Thankfully, the Mac comes with not one, but two firewalls built in. There's the Unix-based ipfw application, which has shipped with every Mac since OS X was introduced, and the Application Firewall, which was introduced in OS X 10.5 and has undergone significant refinement since.

The difference between the two is simple: ipfw is a port-based firewall, while the Application Firewall is, as its name suggests, application-based. That is, ipfw looks at specific ports on which network traffic is coming into the Mac and makes sure it's all kosher, while the Application Firewall looks at traffic associated with certain applications and blocks whatever hasn't been authorised.

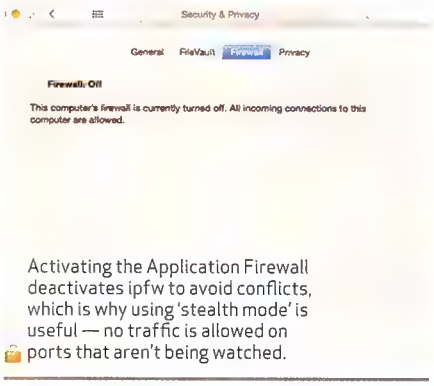
In this context, a port isn't the same as a physical connector on the outside of your computer. There are literally tens of thousands of virtual ports on which network traffic can travel, and well-behaved applications use specific ports for their traffic.

Obviously, configuring a firewall to monitor tens of thousands of ports is not a trivial task, so ipfw tinkering is the realm of serious geekdom. If you don't activate the Application Firewall, ipfw operates in a good-enough-for-most-people default mode to keep you reasonably safe.

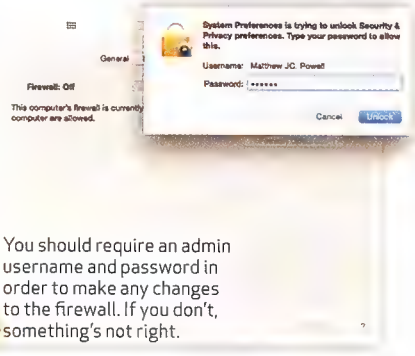
There are third-party utilities available, which make ipfw simpler to use (for example, Norton Personal Firewall is really just a graphical interface for ipfw), although for most people, the Application Firewall is as good and much easier to use.

To turn on the Application Firewall, go to 'System Preferences > Security & Privacy' pane and then click on the Firewall tab. If you are then told that the firewall is off, click the button to

The Application Firewall is accessed via the 'Security & Privacy' pane of 'System Preferences'.



Activating the Application Firewall deactivates ipfw to avoid conflicts, which is why using 'stealth mode' is useful — no traffic is allowed on ports that aren't being watched.



You should require an admin username and password in order to make any changes to the firewall. If you don't, something's not right.

"ipfw is a port-based firewall, while the Application Firewall is, as its name suggests, application-based."

'Turn Firewall On' (note that it may be necessary to enter an admin username and password).

And that's more or less it, if you're happy enough for Apple to decide which of your applications can communicate over the network and which cannot. However, you shouldn't be, so let's investigate further.

CLICK ON FIREWALL OPTIONS

In the next pane, you'll see the option to 'Block all incoming connections' – only click on this if you're very paranoid and really only want a minimally useful Mac. Nothing aside from web browsing and email that requires a network connection will work. If you share your iTunes library with other people in the house, for instance, they will get very cranky.

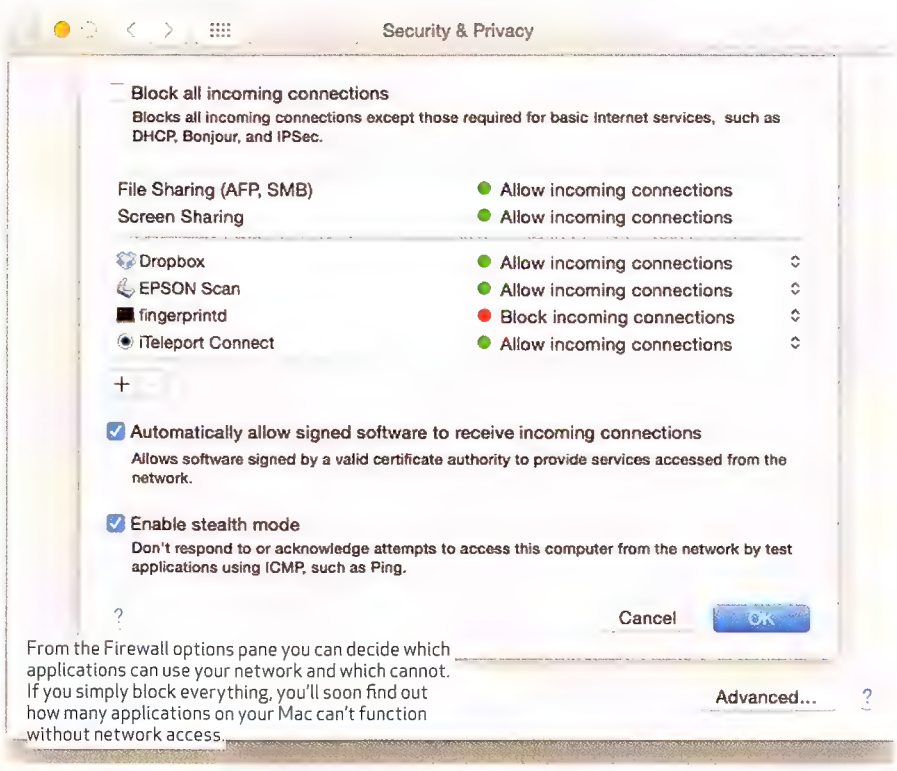
If you're not blocking all incoming connections, you have the option to set access for specific applications. And this is where the simplicity of the application-based firewall wins over ipfw: you don't need to know which ports a particular application wants to use, only whether or not you want to allow it to use your network.

To add an application to the list, click on the '+' symbol and then navigate to its location using the Finder. Once it's added to the list you have the option to allow or block it. Services that require network access (for example, File Sharing if you've activated it under the Sharing pane of 'System Preferences') are added to the list automatically and cannot be blocked. Again, you have no need to know which ports any of these applications or services use.

Next, you have the option to allow 'signed' applications (software that has a valid security certificate) automatically. Generally speaking, this is pretty safe. If you tick this and then run an unsigned application, you will be asked whether to allow or deny it. If you deny it, it will be added to the list and blocked. (You can also add signed applications to the list and explicitly block them yourself if this is necessary.)

Finally there's the option to 'Enable stealth mode'. This is a handy thing to do regardless of whatever else you do with your firewall. Basically, it means that if any malware, bots or other nasties go looking for computers on the internet, they won't find yours. Any 'ping' requests your Mac receives will not be bounced back – just ignored. It's as if a burglar went up to your front door to try the lock and discovered that your house wasn't even there. Cool.

A word of warning, though. Once you activate your firewall, things can get a little annoying for a while. That chat program you like to use may or may not be signed, so you might have some problems with it until it's configured.


Security & Privacy
Block all incoming connections
Blocks all incoming connections except those required for basic Internet services, such as DHCP, Bonjour, and IPSec.
File Sharing (AFP, SMB)
Allow incoming connections
Screen Sharing
Allow incoming connections
Dropbox
Allow incoming connections
EPSON Scan
Allow incoming connections
fingerprintd
Block incoming connections
iTeleport Connect
Allow incoming connections
Automatically allow signed software to receive incoming connections
Allows software signed by a valid certificate authority to provide services accessed from the network.
Enable stealth mode
Don't respond to or acknowledge attempts to access this computer from the network by test applications using ICMP, such as Ping.
Cancel
OK
Advanced...
From the Firewall options pane you can decide which applications can use your network and which cannot. If you simply block everything, you'll soon find out how many applications on your Mac can't function without network access.

Adding applications to the list of allowed network users is a simple task, as is removing them. Some applications may need to be added to the list and then explicitly blocked. You'll figure it out as you go.

There might be a utility you're running in the background doing something very useful, which it can no longer do because it requires network access. Expect to have a few awkward days while you work out your particular firewall needs.

The Application Firewall also doesn't monitor any outgoing traffic, only incoming. This isn't a huge problem yet, as spyware and keyloggers aren't really a thing for Macs so far. If you want to keep an eye on applications sending traffic out from your Mac, there's a utility called Little Snitch (**www.obdev.at/products/littlesnitch/index.html**) that can do it for you. It costs US$34.95, but offers a demo mode for free, so you can install it and see whether it's right for you.

Secure your Linux laptop

If you can't keep your laptop or smartphone out of the hands of thieves, Neil Bothwick shows you how to keep their contents safe.

We often talk about security in terms of password management or encrypting data, but portable devices present another potential problem and that's physical theft. It's easy to say that you need to 'be careful' to avoid the theft of your devices, but what can you do to mitigate the damage if your laptop or smartphone is stolen? We will look at some ways of keeping your data secure should it fall into the wrong hands somehow, while avoiding adding so many layers of security that it becomes impractical or you just you don't want to use it.

Using strong passwords is always vital, but even more so in the case of a mobile device. If someone takes you laptop, they will be able to try and break your passwords at their leisure. Programs like John the Ripper can use brute force to crack the passwords from your system – provided the attacker has access to your password files and plenty of time.

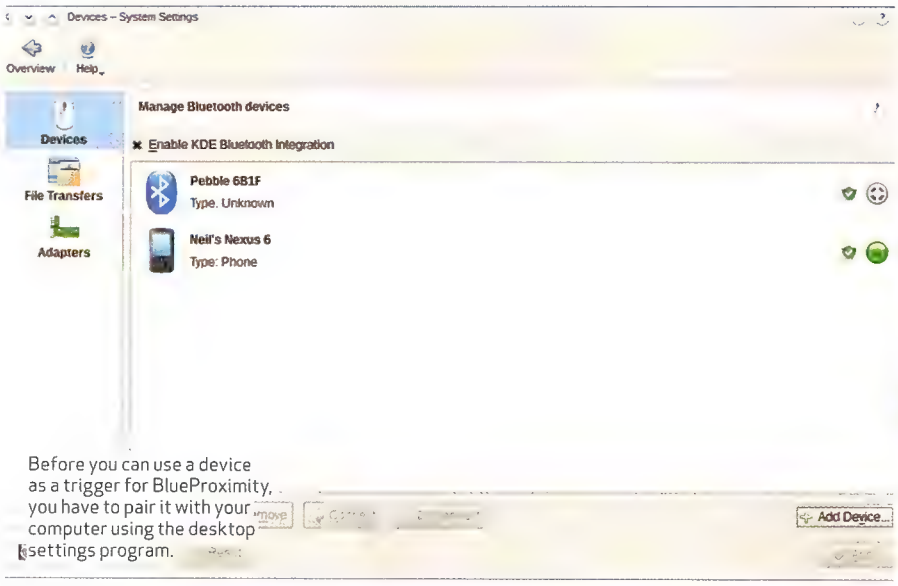
You can't do anything about the time but you can make your important files unreadable. Requiring root access to them is not enough because they could easily boot the computer from a rescue CD and read anything as root, so encrypting your hard disk should be a priority.

We've covered encrypting your home directory previously, although encrypting the whole drive means you will either have to reinstall or back everything up and encrypting the drive with `dm-crypt`. While it's a lot of work, you really should consider encrypting the whole drive when you install a Linux distro. You should also set a BIOS password to prevent anyone changing the settings to allow booting from another medium.

LOCK OUT

An encrypted drive or home directory is only part of the solution. It stops anyone using a live CD to read your disk, but if the laptop is stolen, while it's already switched on, your data is available for all to see. There is a simple solution to this: the easiest way to carry a laptop is with the lid closed, so could you lock your computer when the lid is closed? The answer is yes. The ACPI system reacts to various events, including closing and opening the lid. This is often used to power off the screen to prolong battery life, but you can also have it lock the screen.

The details vary from desktop to desktop; in KDE you set the lid closed action in the 'Power Management' section of the settings, Gnome users should look in Privacy, and for Unity it's under 'Security & Privacy'. It is also possible to set this up independently of the desktop environment. Systemd users can edit '/etc/systemd/logind.conf' and set `HandleLidSwitch` to `lock`. Alternatively, you can have ACPI handle this directly by installing xlock from your package manager and then creating a file called



Before you can use a device as a trigger for BlueProximity, you have to pair it with your computer using the desktop settings program.

'/etc/acpi/events/lid' containing:

```
event=button[ /]lid.*close
action=sudo -u youruser /
usr/bin/xlock -display :0
```

This runs xlock to lock your display when the lid is closed, so you will need to enter your password to unlock it. We use `sudo` to run it as your user because the ACPI daemon runs as root, and xlock wants the password of the user that ran it. You will need to restart the acpid service after creating or editing this file.

Most distros disable the use of Ctrl-Alt-F1 to get to a virtual console, which is something you should consider as xlock only locks the X display. You can do this by adding the following to '/etc/X11/xorg.conf' or a file in '/etc/X11/xorg.conf.d':

```
Section "ServerFlags"
  Option "DontVTSwitch"
"true"
EndSection
```

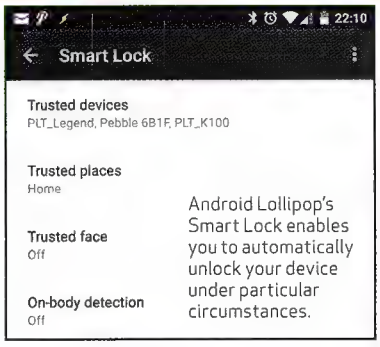
PROXIMITY LOCKING

This method has two disadvantages: first, it relies on a thief closing the lid, which isn't really such a problem, and it means you have to type your password every time you open it – and we just advised you to use a strong one.

The Android options

We have mainly considered laptops running desktop Linux, but mobile devices running Android can easily be lost. Protecting the device with a PIN or pattern to unlock it is more secure, but a lot less friendly. Fortunately, the Lollipop edition of Android (5.x) has a feature called Smart Lock, found in the Security settings, that allows you to bypass the lock when certain conditions are met. Currently this works on GPS location or the presence of a Bluetooth device. For example, you can disable the lock when you are at home or in your car.

Locating and even remote wiping a lost smartphone can easily be done from Google's device manager at **www.google.com.au/android/devicemanager**. You can make your phone even more secure by enabling two-factor authentication and selecting the setting to require a PIN when turning it on.



Android Lollipop's Smart Lock enables you to automatically unlock your device under particular circumstances.

Of course, it would be handy if the laptop worked when you were using it, but not for anyone else. We are not talking fingerprint scanners here, but something that almost most users will already have: a smartphone. BlueProximity (**sourceforge.net/projects/blueproximity**) monitors a paired Bluetooth device and when it moves a certain distance away, it locks the computer; when the device comes back in range, it unlocks it. If your phone always lives in your pocket or hand, it works well. It's even better if you link it to a smartwatch.

The first step is to pair your Bluetooth device with your computer, using your desktop's settings tools. Then you can start BlueProximity. Starting it from the launcher appears to do nothing, so check the system tray as it may have started up hidden. Start by clicking on the Scan button. Select your device in the Detected list and click 'Use selected device', which will copy its MAC address to the field below. Then set up the detection parameters in the 'Proximity Details' tab.

The distance settings are actually measurements of signal strength, which means the higher the number, the weaker the signal or the greater the distance. The duration controls how long your device should be past that distance before BlueProximity acts. If you want to set a specific distance, click the 'Reset Max/Min' button, take your device to the distance at which you want locking to occur and wait a few seconds – come back and you will see the maximum distance registered at the bottom of the display. For most uses, the defaults should be close enough: it's normal to set the locking distance to be greater than the unlocking distance, otherwise you may find it locking and unlocking when you are close to the common setting. Setting the duration too short can also cause unexpected events because the Bluetooth signal strength reading can fluctuate.

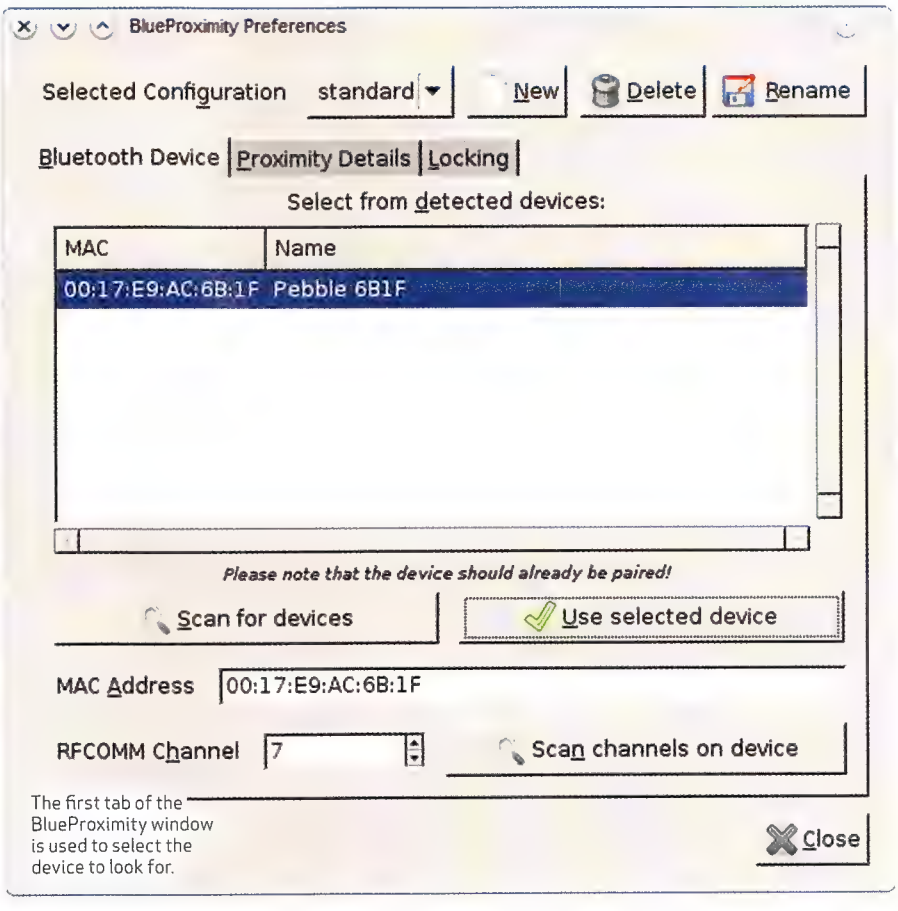
The third tab sets the commands to run on lock and unlock. The default is to run gnome-screensaver, so click the arrow button to use xscreensaver instead or type in your own command. BlueProximity will not run the lock commands while its window is open, but it will change the key's colour in its icon to show whether you're in range. Green and red have the obvious meanings, while yellow means you are within lock range, but outside of the unlock distance. The proximity command is run whenever your device is in range, at the interval specified. The default is to keep gnome-screensaver from blanking the screen, even if you don't touch the keyboard or mouse.

You may need to experiment a little with these settings, but you will end up with a computer that can only be used when your Bluetooth device is nearby.

FINDING A LOST DEVICE

Should the worst happen and your device is stolen, there is something you can do to track it or protect your precious data. By installing the Prey (**preyproject.com**) client on your computers and mobile devices, and setting up a free account, you will be able to get at your computer when it's online, even if someone else has it. The basic service is free, with various levels of premium service for extra features and devices, although the free option works with up to three devices and gives a good level of reassurance.

There are other services available, such as Cerberus, but Prey has the advantages of being open source and able to run on all desktop and mobile operating systems. ■



The first tab of the BlueProximity window is used to select the device to look for.

Create books on iPad

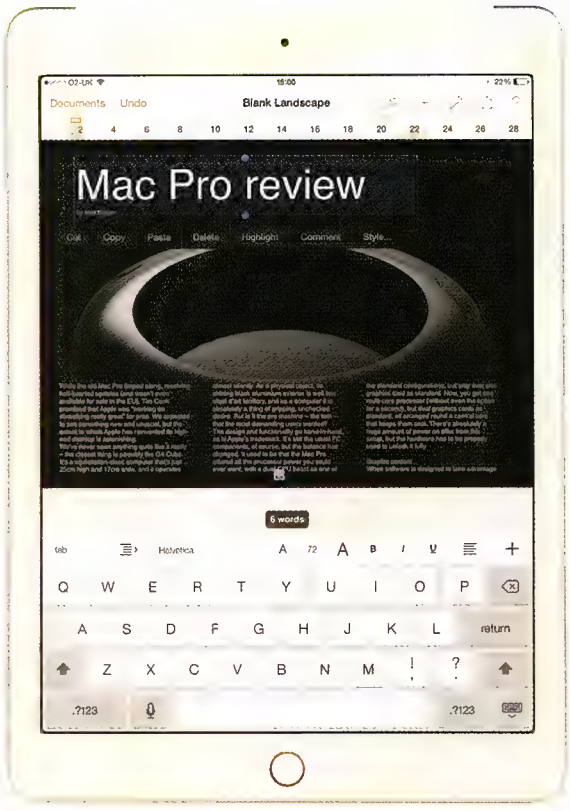
Powerful publishing on the move is now even easier with Pages.

All the iWork apps got a makeover back with the release of iOS 7, and for owners of devices bought after September 1, 2013, all three are now free. Using Pages on an iPad is a much more pleasant experience than on an iPhone because of the screen size, and creating documents on your iPad is very straightforward, largely thanks to the templates available and the effective use of touch controls.

Start by choosing one of the 63 available templates, and then customise it until it fits the bill precisely. Don't like the headline typeface? Change it. Size and colour? You can change those, too. Images can be replaced with photos from your Photos app, and there are dozens of shapes from which to choose to add to documents. We particularly like the image masking feature, which allows you to choose which part of an image to display and mask out the rest.

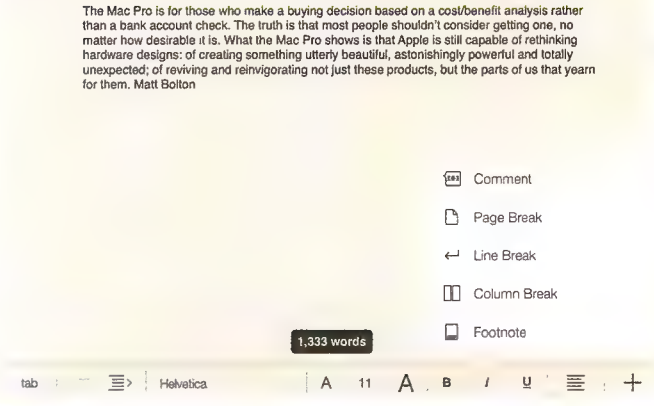
The range of style options for objects is impressive, and formatting is excellent, too. When you're done creating, you can print your work if you have access to an AirPrint printer, save it to your iCloud, send it to iTunes or share it over email.

Pages on iPad is easier and more fun to use than the small-screen version, but if you also have an iPhone you'll still find it a great app to do quick edits.



Pages basics

Make pages within Pages on iOS.


The Mac Pro is for those who make a buying decision based on a cost/benefit analysis rather than a bank account check. The truth is that most people shouldn't consider getting one, no matter how desirable it is. What the Mac Pro shows is that Apple is still capable of rethinking hardware designs: of creating something utterly beautiful, astonishingly powerful and totally unexpected; of reviving and reinvigorating not just these products, but the parts of us that yearn for them. Matt Bolton
Comment
Page Break
Line Break
Column Break
Footnote
1,333 words
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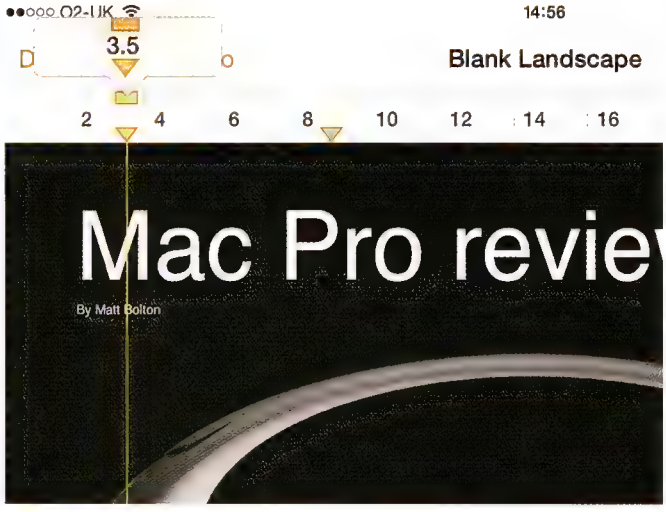
U

1 GETTING A NEW PAGE

Sometimes, the pretty, stripped-back interface of Pages can be somewhat confusing – and irritating. He's a case in point: you could spend ages trying to work out how to get the application to create a fresh new page for a multi-page word processing document, when in fact the command is hidden behind a menu. With the keyboard showing, simply tap the + button and you'll get all the options you need for line breaks, column breaks and the all-important page breaks.

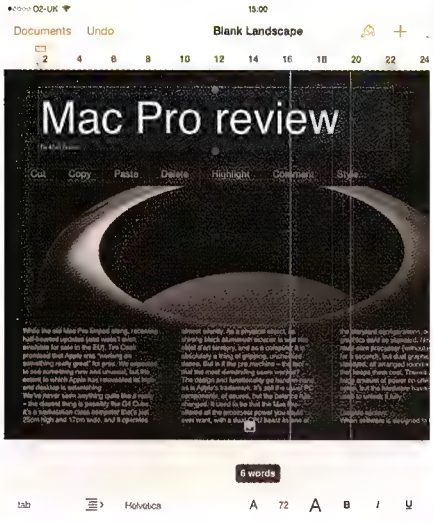


2 ADJUST PAGE MARGINS

To adjust the size of your document, you can manipulate the page margins simply using the ruler. To display the ruler, just tap the Spanner icon at the top and then go to 'Settings > Ruler'. To align your text, set the tab stops along the ruler to align text on the left, right, centre or decimal point. Tap to place the insertion point and then drag the icon for the tab stop until it's in the correct position. You can insert as many tab stops as you want, and then hide the ruler by tapping Done.

Working with text

Edit text like a pro.

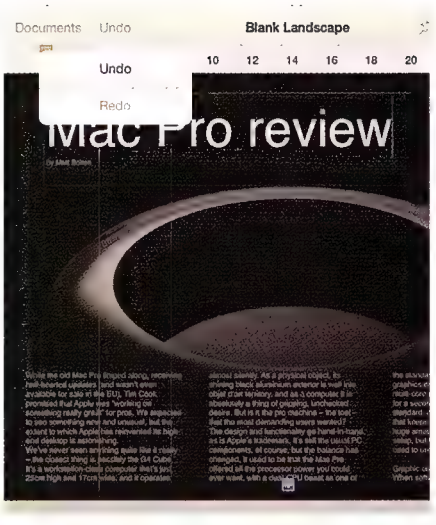


1 SELECTING TEXT

It's not obvious how to select text in Pages. You can double-tap to select a word or triple-tap to select an entire paragraph at once. If you want to select all the text, you can either tap and hold, then choose 'Select All' from the menu that pops up, or use C-A on a paired Bluetooth keyboard. If you want to adjust the selection, tap to grab the blue handles and drag forwards or backwards with your finger.

2 USING THE SPELLCHECK

Suspected misspellings are shown with a dotted red underline. To correct them, double-tap on the typo, tap Replace and select the correct word from the suggestions. If there's only one available suggestion, you're shown this as soon as you tap on a word, and can tap to accept it. This menu also tells you if the spellchecker is totally stumped and has no replacement word available.



3 UNDOING TEXT ERRORS

Sometimes you will move an image accidentally or make a mistake while you're typing. This can be easily fixed in the iPhone version of Pages by simply shaking your phone and then selecting either Undo or Redo, as appropriate. On the iPad, you'll find the two options in the top-left corner. Undo reverses the last action, while the accompanying Redo option undoes the undo!

Managing images

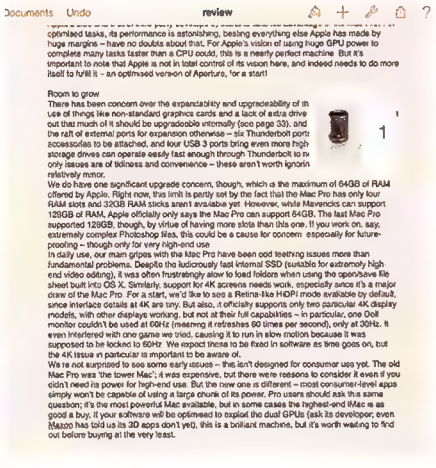
Make documents more interesting.

1 ANCHORING IMAGES

Images and shapes can be anchored so that they move with the text – this is usually referred to as an inline image – or float above the text, with the option of wrapping text around the graphic. Insert your image, and then tap the Paintbrush icon. Tap 'Arrange > Wrap' and configure your anchor and wrap options from there (a little diagram helps by describing the effect of each preference).

2 CROPPING PICTURES

If the picture you want to use is the wrong shape for your layout, you can use the 'Edit Mask' command under the Image tab in the Paintbrush menu. This allows you to crop images, as well as zoom and pan the picture inside the mask. It's a bit like moving a huge poster around outside a window, except that you can alter the size of the window, along with the size of the poster.



3 SKIM LONG DOCUMENTS

Even with flick gestures, it could take you a long time to scroll through a big document. Happily, Apple has you covered: tap and hold for a split second at the right of the screen, and up pops the navigator. Slide your finger slowly up and down the screen, and you'll see the pages stream past in the magnifying glass under your fingertip – the pages in the document are displayed as thumbnails.

Additional features

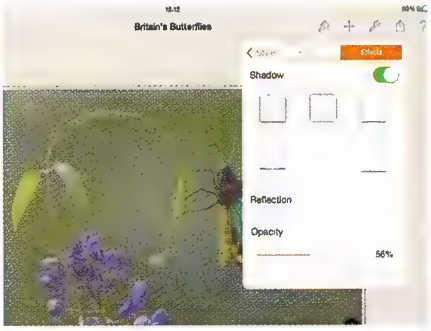
Go even further with Pages.

1 UNDO/REDO

If you've spent ages typing out a long document, only to delete a section by mistake, or if you've simply mistyped something, you want to be able to undo. You get an Undo button in the top left. On an iPhone you can simply shake to bring up the Undo option.

2 ADJUST MARGINS

While in your document, tap the Spanner icon and choose 'Document Setup'. The view will change to vertical and display the margins. Adjust these by tapping and dragging the arrows. Alter the paper size by tapping 'Change Paper Size' at the bottom of the screen.

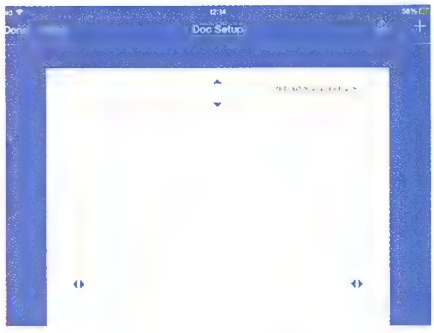


3 IMAGE WATERMARKS

To turn an image into a watermark, add the image you want to use and resize it to fit the area. Then tap the Paintbrush icon and select 'Style Options (Style tab) > Effects'. Now drag the opacity slider down. Options for Shadow and Reflection can be found above the slider.

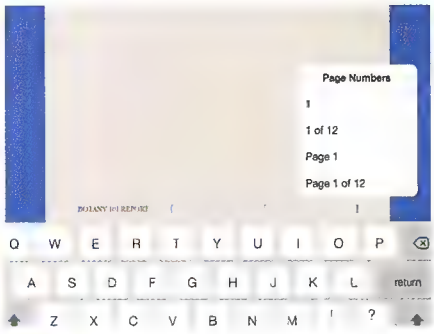
4 CREATE TAB STOPS

Bring up the ruler by tapping on some text, then select the text you want to adjust, and tap along the ruler to insert tab stops. Double-tap the icon to change the tab type: a diamond indicates centre-aligned, a triangle pointing left is right-aligned, while a circle is decimal-aligned.



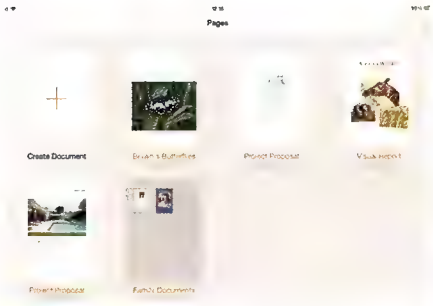
5 HEADERS AND FOOTERS

Open your chosen document, tap the Spanner icon and then choose 'Document Setup'. At the top and bottom of the page you can type in the little boxes. Type your text and you're done. This adds it to the 'Section Master' so the header/footer appears on every page.



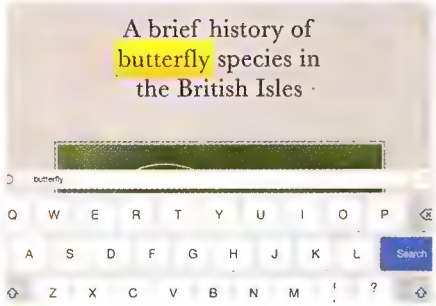
6 PAGE NUMBERS

To add page numbers, follow the same route as for headers and footers, but when you tap on either the header or footer bar, select the 'Page Numbers' tab that pops up at the same time as the on-screen keyboard. Select the numbers from the menu and then tap Done.



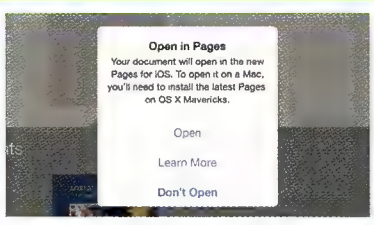
7 TIDY UP

You can group documents into folders and arrange by date or file name. In the documents view, tap Edit and then tap to select the documents you want in a folder. Tap and hold one until they all merge, and then drag them over another document you want.



8 FIND TEXT

Tap the Spanner icon, select Find and a Search bar will appear on the page. Enter the text you want to search for and it will be highlighted. Tap the Settings icon (the cog) on the left and you can also do a find and replace of words in the text of your Pages document.


Open in Pages
Your document will open in the new Pages for iOS. To open it on a Mac, you'll need to install the latest Pages on OS X Mavericks.
Open
Learn More
Don't Open

Import attachments

You don't have to use iTunes to get documents into Pages on your iPad. You can send Pages or Word documents as attachments to an email. On receipt, tap and hold the file's image in the email and select 'Open in Pages' from the options.

techradar.

TECHNOLOGY, TESTED

Install Ubuntu on your Pi 2

Can you use Ubuntu on the Raspberry Pi as an everyday desktop? Certainly! Mayank Sharma explains how.

The release of the Raspberry Pi 2, equipped with a new quad-core ARMv7-based processor, brought with it a host of new supported distributions, including the popular desktop distro, Ubuntu. Soon after the announcement, third-party Ubuntu images, which were compiled to exploit the new architecture, began popping up on forum boards across the internet. While the official Ubuntu image (see box on page 96) is a lightweight command-line version of the distro, the unofficial images were much fuller, complete with a desktop and a host of applications.

One of the best Ubuntu images currently available is put out by the Ubuntu MATE project. The image is based on the latest Ubuntu 15.04 release and uses the MATE Desktop 1.8.2. Additionally, the desktop includes a large number of apps and can be easily fleshed out using the bundled Ubuntu Software Center. What makes it even more special is the fact that this image isn't just for demo purposes, but is very usable on the rejuvenated Pi 2.

You can grab the image as a compressed archive from Sourceforge at **tinyurl.com/qbveekd**. The latest version available at the time of writing is ubuntu-mate-15.04-desktop-armhf-raspberry-pi-2.img.bz2. Once you've downloaded the archive, you can extract the .img file out of it with:

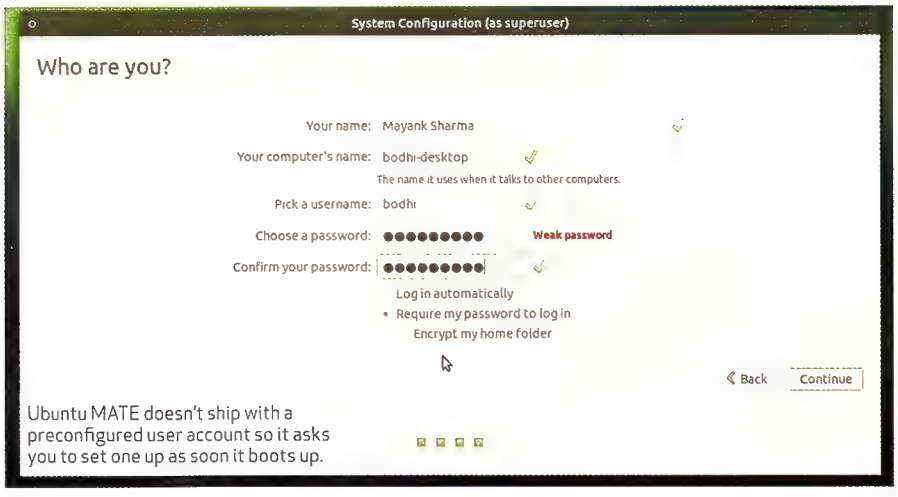
```
$ bunzip2 ubuntu-mate-15.04-desktop-armhf-raspberry-pi-2.img.bz2.
```

The developers suggest using the ddrescue tool to transfer the image onto your Pi's SD card. Install this tool with this command:

```
$ sudo apt-get install gddrescue
```

Now insert the card – which needs to be at least 4GB in size – and use the `lsblk` command to find its mount point. Assuming that it's mounted on /dev/sdb, transfer the image file to the card with:

```
$ sudo ddrescue -d -D --force ubuntu-mate-15.04-desktop-armhf-raspberry-pi-2.img /dev/sdb
```


System Configuration (as superuser)
Who are you?
Your name: Mayank Sharma
Your computer's name: bodhi-desktop
The name it uses when it talks to other computers.
Pick a username: bodhi
Choose a password:
Weak password
Confirm your password:
Log in automatically
Require my password to log in
Encrypt my home folder
Back
Continue
Ubuntu MATE doesn't ship with a preconfigured user account so it asks you to set one up as soon it boots up.

If you are on a Windows computer, you can use 7-Zip to extract the image file from the archive, which you can then transfer onto the card with Win32 Disk Imager. The Raspberry Pi lacks a BIOS, so if you wish to edit its hardware configuration, you have to manually edit the config.txt file (see box opposite). Now plug the card into your Raspberry Pi 2 and power it up.

INITIAL CONFIGURATION

The first time the distro boots up, it brings up a four-step installation and configuration wizard. In the first step, you are asked to select the default language for the distro, followed by the time and the keyboard layout. In the final step, you are asked to create a user account. This screen should be familiar to anyone who's previously installed Ubuntu on the desktop. You can also choose to toggle the option that enables you to log directly into the desktop. There's also the option to encrypt your home folder but we advise you against enabling this because the option adds a processing overhead on the limited resources.

Once you've configured the distro, it is installed onto the card with these settings. When it's done, you're dropped at the MATE desktop login screen, from where you can log in to the desktop. Before going any further, however, you should resize your installation image to take over all the remaining free space on the card. Unlike Raspbian, which includes a CLI configuration tool that does this for you, on the Ubuntu MATE image you have to resize the partitions manually. Fire up the MATE terminal and launch the Fdisk command-line disk partitioning utility with:

```
$ sudo fdisk /dev/mmcblk0
```

Use the 'P' key to print the current partition table. We'll now delete the second partition and recreate it to take over the entire card. Press 'D' and, when asked, enter '2' to delete the second partition. Press 'N', followed by 'P' and '2', to create a new primary partition. Fdisk will ask you to enter the physical dimensions of the partition. Don't sweat – just press Enter twice to select the default options. When you're back at the main menu, press 'P' again to view the two partitions. Taken together, the size of both these partitions should equal the size of the card. When you've verified this, press 'W' to save the partition table and exit the Fdisk utility. Now close the terminal and reboot the device.

When you're back up again, head to the terminal and enter the following command to extend the file system:

```
$ sudo resize2fs /dev/mmcblk0p2
```

The command takes some time to complete, depending on the size and the speed of the SD card you're using. Unlike the desktop version, MATE for Raspberry Pi doesn't include a swap space. If you are using an SD card greater than 8GB, install the following to automatically create a 2GB swap space:

Editing BIOS settings

The Pi doesn't include a BIOS setup utility, but you can tweak the various system configuration parameters by manually editing a text file. On a running Ubuntu MATE installation, you'll find this file under the boot directory (specifically, /boot/config.txt). Open the file in a text editor with `sudo nano /boot/config.txt`. You can also edit the file while the distro isn't running. To do this, remove the card from your Pi and connect it to a PC running Linux, Windows or Mac OS X. Mount the card and use the file manager to look for the config.txt text file. Irrespective of how you access the file, its contents will remain the same. The file is divided into various sections. The hash symbol (#) in front of the options is used to comment out or disable that option. You can only specify one option per line.

If you plug in the Pi to your HDMI monitor or TV and get no picture, scroll down to the #hdmi_safe=1 option and uncomment it by removing the hash symbol. Then save the file and restart the Pi. When you do get the display but it doesn't stretch across the screen, find #disable_overscan=1 and uncomment it.

Adventurous users can also overclock the Pi from this file. By default, the Pi runs at 700MHz although you can safely run it at 800MHz. While many people run their Pi at over 1GHz, make sure you take the necessary precautions first, including installing a heatsink. To overclock the Pi, scroll down to the bottom of the file and uncomment the arm_freq=800 parameter. Upon restart the Pi will be running at 800MHz.

```
$ sudo apt-get install dphys-swapfile
```

Again, this step takes some time because the utility earmarks space for use as a swap space. The final bit of configuration is to check whether the module for the Raspberry Pi's audio hardware has been enabled. To do this, enter the following in a terminal:

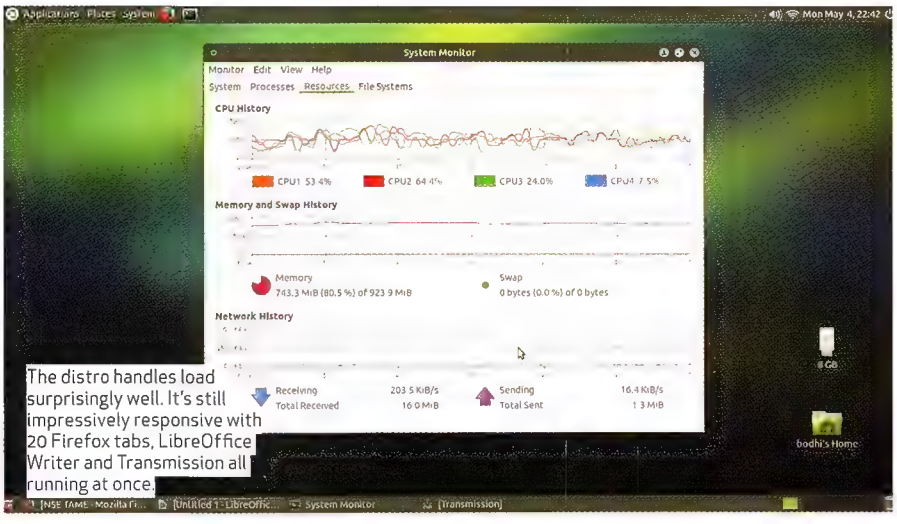
```
$ lsmod | grep snd_bcm2835
```

If the command prints no output, you have to manually load the module with:

```
$ sudo modprobe snd_bcm2835
```

To make sure the module is loaded on subsequent boots, enter the following in a terminal:

```
$ echo "snd_bcm2835" | sudo tee -a /etc/modules
```



The distro handles load surprisingly well. It's still impressively responsive with 20 Firefox tabs, LibreOffice Writer and Transmission all running at once.

That's a fully-fledged version of the Ubuntu MATE 15.04 distro running on the Raspberry Pi 2.

USING THE DESKTOP

If you're used to the Raspbian distro, the MATE edition will be a pleasant surprise. Not only does the desktop look different, but it's also flush with applications. The MATE desktop is the continuation of the Gnome 2 desktop, which also makes it lighter than mainstream desktops, such as Gnome, KDE and Unity. To complement its lightweight disposition, the distro uses resource-friendly apps including the Caja file manager, Pluma text editor, Eye of MATE graphics viewer, Atril document viewer, and more.

Surprisingly, the distro also includes popular feature-rich apps you'd find on a regular desktop distro, such as the Firefox browser, Thunderbird email client, Rhythmbox audio player and the LibreOffice office suite. Even more surprising is that these apps make good use of the extended processing power of the new Raspberry Pi 2 and perform rather well. Although we haven't stress-tested the distro or the device, MATE 15.04 on the Raspberry Pi maintained its impressive performance through several hours of usage. One app that isn't of much use, though, is the VLC Media Player. Despite adding support for hardware acceleration with the GPU on the Pi, playback with the popular media player isn't very impressive, especially with high-resolution videos. Instead, you should use the command-line Omxplayer, which works very well and is also installed on the distro.

If you want a graphical client for Omxplayer, you can install the browser-based OmxWebGUI. The advantage of this client over others is that you can use it to control playback from any computer on the network. Although it's still in the

early stages of development, it works perfectly and hasn't ever misbehaved on any of our installations.

Before you can install the client, you need to fetch its dependencies with:

```
$ sudo apt-get install git php5-cli
```

Now fire up a terminal and fetch the client with:

```
$ git clone https://github.com/brainfoolong/omxwebgui
```

This creates a directory called omxwebgui under your home directory. Then enter the following command:

```
$ php -S 0.0.0.0:1234 -t ~/omxwebgui > /dev/null 2>&1 &
```

This command creates a simple PHP web server that's listening for connections on port 1234 of the Pi. Assuming the IP address of the Pi is 192.168.3.111, fire up a web browser on the Pi or on any computer on the network and navigate to 192.168.3.111:1234. This will bring up the graphical interface for Omxplayer. Use the text box at the top of the page to specify the path to the folder that houses your media files and click Save. Then click on the status bar and select the file you wish to play. You can control playback using the buttons on the interface.

To further enhance your multimedia experience, you can also equip the web browser on the Pi to handle Flash content. Because Adobe doesn't release new versions of the Flash player for Linux, we'll use Google's Pepper Flash player instead. For this to work, though, you have to install the Chromium web browser first. Fire up a terminal and type:

```
$ sudo apt-get install chromium-browser chromium-codecs-ffmpeg-extra
```

Then download the Pepper plug-in ripped by a Raspberry Pi forum board member. The latest version at this time is 15.0.0.2.152, and you can download it with:

```
$ wget -c http://odroidxu.leeharris.me.uk/PepperFlash-15.0.0.152.r2-armv7h.tar.gz
```

Now extract the plug-in into Chromium's plugins directory with:

```
$ sudo tar zxf PepperFlash-15.0.0.152.r2-armv7h.tar.gz -C /usr/lib/chromium-browser/plugins/
```

Finally, edit the browser's configuration file to make it aware of the plug-in:

```
$ sudo nano /etc/chromium-browser/default
```

Add the following line:

```
CHROMIUM_FLAGS="--ppapi-flash-path=/usr/lib/chromium-browser/plugins/libpepflashplayer.so --ppapi-flash-version=15.0.0.152 -password-store=detect -user-data-dir"
```

That should do it. Now launch Chromium and enter `chrome://plugins` in the address bar, which lists the enabled Flash plug-in next to the others. While you can now browse

"You can also equip the web browser on the Pi to handle Flash content."

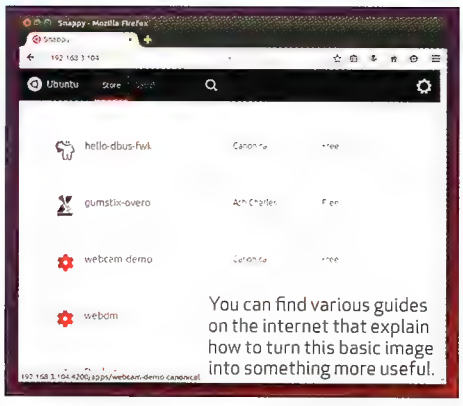
Even if you aren't turned off by the CLI, use the Omxplayer web client to control playback from a remote device.

Official Ubuntu for Raspberry Pi 2

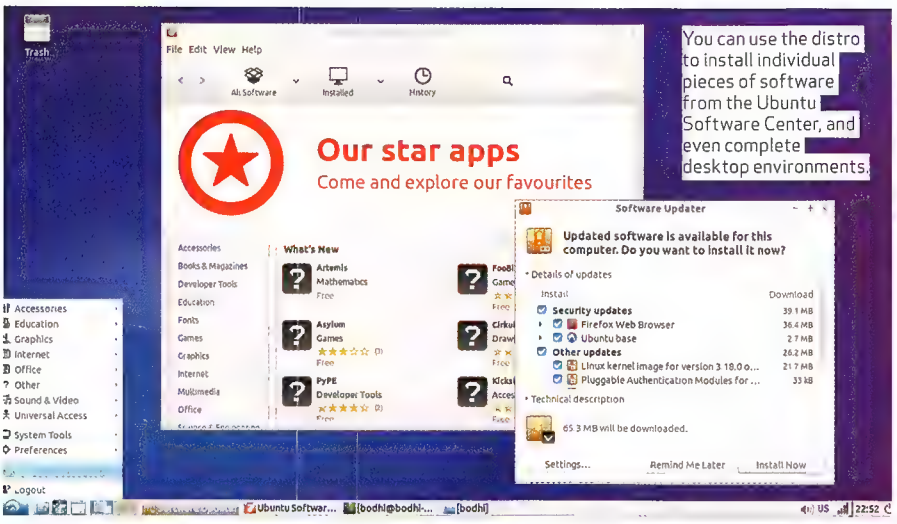
The official Ubuntu release for the Pi 2, dubbed Ubuntu Snappy, is a minimal server image that uses the same libraries as the mainstream release. Besides missing a graphical desktop, the biggest difference in Ubuntu Snappy is that it doesn't use the apt-get package management system, and uses the new containerised system instead, which Canonical claims to be 'snappier' and gives the distro its name.

Although it's meant for developers, you can take Snappy for a spin — download it from **www.raspberrypi.org** and transfer it to a card like any other Pi distro. After booting it up, type `snappy info` to get details about the installed packages, which you can update with `snappy update-versions`. If you get a certificate error, set the date and time using the format mmddhhmmyyyy.ss. For example, `sudo date 050411342015.00` sets the date and time to May 4, 2015, 11.34pm.

The distro is still under development and supports a limited number of packages. You can search through them with `snappy search <package-name>`. To simplify the task, install the WebDM web-based package manager with snappy install webdm. Once installed, navigate to port 4200 on the RPi IP address to view Snappy's app store.



You can find various guides on the internet that explain how to turn this basic image into something more useful.


You can use the distro to install individual pieces of software from the Ubuntu Software Center, and even complete desktop environments.
Our star apps
Come and explore our favourites
Software Updater
Updated software is available for this computer. Do you want to install it now?

Flash content on the Raspberry Pi, you can't use it to connect to streaming services such as Netflix.

SET UP FOR REMOTE ACCESS

The Ubuntu MATE image doesn't include the OpenSSH server, so you can't manage it from a remote machine out of the box. To rectify this, head to the terminal and enter:

```
sudo apt-get install
openssh-server
```

You can now securely log into the Pi from any machine on the network. The `sudo ssh mayank@192.168.2.111` command asks for authentication information for the user account named mayank before logging you in. Change the username and IP address for your installation and network.

The new Pi also has enough resources to pipe your desktop to a remote machine via the VNC protocol. If you wish to enable remote desktop on the Ubuntu Pi, first install a desktop that's even lighter than MATE. While we recommend the LXDE desktop, you can also use Xfce. To install the LXDE desktop, enter the following in a terminal:

```
$ sudo apt-get install lxde
```

This command installs the vanilla LXDE desktop. You could instead install a customised version of the LXDE desktop produced by the Lubuntu distro with:

```
$ sudo apt-get install
lubuntu-desktop
```

This command installs both the vanilla and the customised flavours of the LXDE desktop. After you've installed the desktop, you can install the VNC server with:

```
$ sudo apt-get install
tightvncserver autocutsel
```

The command installs the TightVNC server and the Autocutsel package, which lets you share the clipboard between the local and the remote machine. After installing the VNC server, start it and then kill it, like so:

```
$ tightvncserver :1
$ tightvncserver -kill :1
```

Doing this creates the ~/.vnc/xstartup configuration file. Open the file in a text editor and edit it so it looks like this:

```
#!/bin/sh

xrdb $HOME/.Xresources
xsetroot -solid grey
#x-terminal-emulator
-geometry 80x24+10+10 -ls
-title "$VNCDESKTOP Desktop" &
#x-window-manager &
# Fix to make GNOME work
export XKL_XMODMAP_DISABLE=1
#/etc/X11/Xsession

autocutsel -fork

openbox &

/usr/bin/lxsession -s
Lubuntu -e LXDE &
```

Now save the file and then start a fresh instance of the VNC server with:

```
$ tightvncserver :1
```

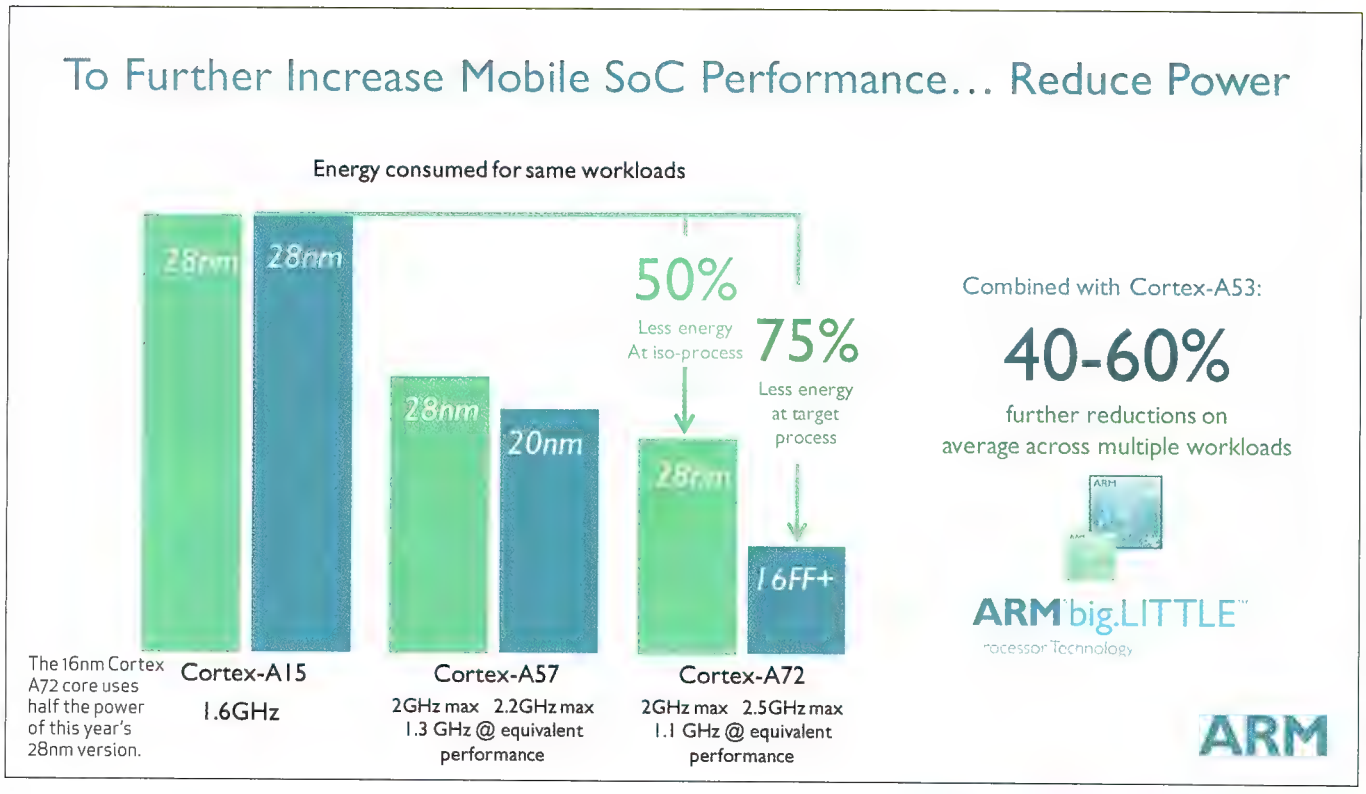
Now that your VNC server is online on the Pi, head to another machine on the same network and install a VNC viewer on it, such as Xtightvncviewer, with `sudo apt-get install xtightvncviewer`. Launch the VNC viewer client and enter the IP address of the VNC server on the Pi, such as 192.168.3.111:1. This should bring up the remote LXDE desktop running on the Pi. In our tests, the Ubuntu MATE image could easily host two VNC sessions on the Raspberry Pi 2 without any noticeable dip in performance.

The Raspberry Pi was conceived as a low-cost computer. Thanks to the efforts of distributions such as Raspbian, the Pi managed to fulfil its maker's vision to quite an extent. But its usage was limited to running lightweight apps and for specialised hobbyist applications, such as an HTPC. But the enhanced juiced-up version 2 has taken it to a whole new level. If the Ubuntu MATE image, which runs effortlessly, is an indication, the Raspberry Pi can now finally be classified as a true mini PC.

Here you can see the Lubuntu desktop on the Raspberry Pi 2 being piped to a remote Linux Mint desktop.

Android CPU roadmap

Huge performance gains, 10-core chips, neural networks and machine learning. Darren Yates peers into the future of processors that'll power the next-generations of Android devices.

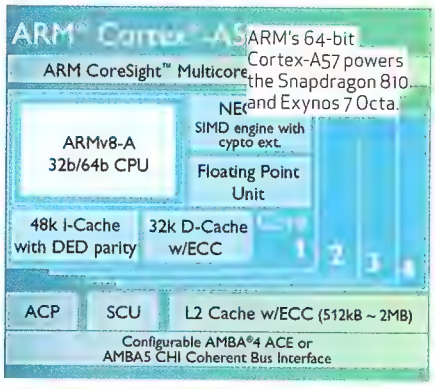


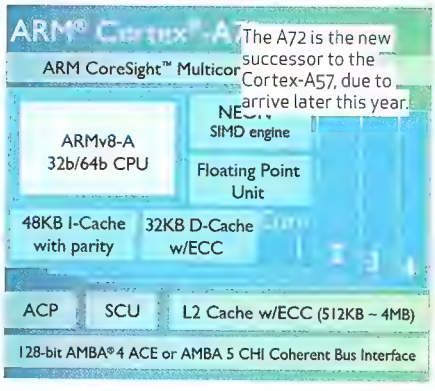
The desktop CPU market holds few secrets these days. We know the chips, the brands that make them and, for the most part, what goes on inside them. We know the CPU cores, the integrated GPU, cache, clock rates – basically, the lot. Even with Apple mobile devices, there's little to surprise and all but no choice – you already know what you're getting.

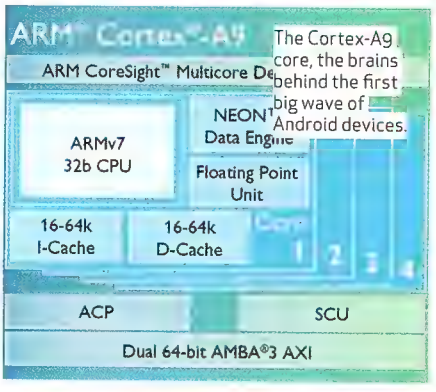
However, open up the Android market and you're drowning in CPU options. It's not really surprising. According to our count, there are at least 25 different chip manufacturers making CPUs suitable to run Android devices – chip giant Intel, making its Atom-class x86 processors, and the other 24 licensing mobile CPU technology from one company, ARM Holdings (**tinyurl.com/3foe9uu**).

ARM CORTEX-A SERIES

While Intel designs and makes its own chips, ARM is quite happy to license its technology to other chipmakers and 'fab-less' brands, companies that license ARM System on a Chip (SoC) tech and either make it themselves or have it made by bespoke chip manufacturers such as TSMC (Taiwan Semiconductor Manufacturing Company) and UMC (United Microelectronics Corporation). Many of the world's major chipmakers are ARM licensees, including Apple, Nvidia, Samsung, Qualcomm, Broadcom – and yep, even Intel (**tinyurl.com/75bojhr**). That's given ARM an enviable share of the mobile CPU market, tipping 85% by the end of 2014


ARM® Cortex®-A57
ARM's 64-bit Cortex-A57 powers the Snapdragon 810 and Exynos 7 Octa.
ARM CoreSight™ Multicore
ARMv8-A 32b/64b CPU
NEON SIMD engine with cypto ext.
Floating Point Unit
48k I-Cache with DED parity
32k D-Cache w/ECC
ACP
SCU
L2 Cache w/ECC (512kB – 2MB)
Configurable AMBA®4 ACE or AMBA5 CHI Coherent Bus Interface

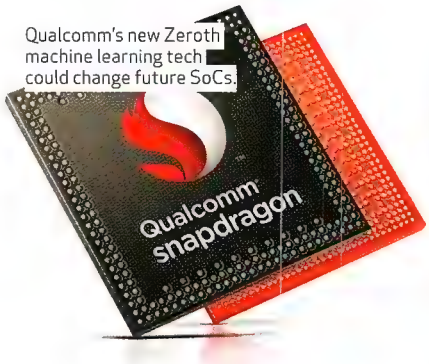

ARM® Cortex®-A72
The A72 is the new successor to the Cortex-A57, due to arrive later this year.
ARM CoreSight™ Multicor
ARMv8-A 32b/64b CPU
NE
SIMD engine
Floating Point Unit
48KB I-Cache with parity
32KB D-Cache w/ECC
ACP
SCU
L2 Cache w/ECC (512KB – 4MB)
128-bit AMBA®4 ACE or AMBA 5 CHI Coherent Bus Interface



(**tinyurl.com/o7uxb8h**). In reality, there'd hardly be a phone or tablet anywhere that doesn't have at least one ARM processor, either running the whole show or providing ancillary features like wireless network communications.

The difference here is that while Intel usually retires its previous-generation CPUs once the next generation arrives, ARM just keeps adding to the Cortex-A-series pile, ready for anyone with the right licence to make them, starting with the A8 and going all the way to the next-generation A72 arriving at the end of 2015. The problem is it's not easy keeping track of all the A-series options in terms of performance, functionality and power consumption, so here's a brief rundown:

- Cortex-A8. The first of the Cortex-A series, the A8 was also the first ARM mobile chip to reach 1GHz. It's inside Apple's A4 CPU and the Samsung Exynos 3110. Today, it still powers BeagleBoard single-board computers and HP t410 smart client PCs.
- Cortex-A5. The first of the low-power A series, the A5 delivers 75% of the A9's performance levels. Scalable up to quad-core, Qualcomm's Snapdragon 200 8x25 series is built on the A5.
- Cortex-A9. The A9's arrival coincided with the rise of Android and iOS, forming the basis of many popular chips including Apple's A5/A5X (iPad 2, 3, iPhone 4S), Samsung Exynos 4x12 (Galaxy S II/S III), Texas Instruments OMAP4-series (Google Glass) and Nvidia Tegra 2 (first-generation Android tablets). Although scalable to quad-core, a single A9 core is up to 50% faster than the A8.
- Cortex-A15/A7. This was ARM's first multi-core big.LITTLE technology aimed at tackling performance and battery life. Both are scalable to quad-core, but the A15 is designed to run high-performance apps, while the A7 delivers power-efficient speed for lightweight work. The A7 can handle those lightweight apps with greater power efficiency than the A15, so a device switches between the two as necessary to maximise speed and power efficiency. Both core designs can also work as standalone SoCs. The A15 powers Nvidia's Tegra 4, Samsung's Exynos 5250 Dual and the Texas Instruments OMAP5 family. ARM grades the A15 at twice as fast as the A9 at web browsing, while the A7 is roughly 10% behind the A9 for speed.
- Cortex-A17. The last of ARM's dedicated 32-bit cores, the A17 is a more power-efficient replacement for the A15, combining with the A7 in ARM's big.LITTLE space. ARM says it's 60% faster than the A9. The new MediaTek MT5595 SoC inside Sony's latest Android TVs has dual A17 and A7 cores (**tinyurl.com/p3nadxn**).
- Cortex-A57/A53. These two formed the first 64-bit big.LITTLE pairing, with the A57 taking over from the A17 and the A53 replacing the A7. ARM rates the A53 as much as 60% faster than the A7 on web browsing (**tinyurl.com/nvteprp**), while the A57 is up to 90% faster than the A15. Samsung uses this pairing inside its Exynos 5433 running the Galaxy S4 and the Exynos 7420 driving the latest Galaxy S6/S6 Edge. Qualcomm has both in its Snapdragon 808 (dual) and 810 (quad) SoCs, MediaTek's Helio X10 has eight A53 cores.



Qualcomm's new Zeroth machine learning tech could change future SoCs.

Redefining the Snapdragon 600 tier with better performance, multimedia, gaming and connectivity

The Snapdragon 620 processor offers many advantages:

+ 4K video capture and playback
+ 64-bit quad ARM® Cortex™-A72 CPU and quad Cortex-A53 CPU

USER EXPERIENCES SUPPORTED

Qualcomm's new octa-core Snapdragon 620 will feature the Cortex-A72 core.

Shoot and play back 4K Ultra HD video

Bringing the most advanced video capabilities from the Snapdragon premium tier to the high tier

Play immersive 3D games at home and on the go

Next generation Adreno GPU provides the efficient processing power needed for amazing visual detail and longer battery life

Stay connected and get faster downloads

Make better use of your time with X8 LTE with data speeds of up to 300 Mbps download/100 Mbps upload

HOW TO TRAIN A SNAPDRAGON

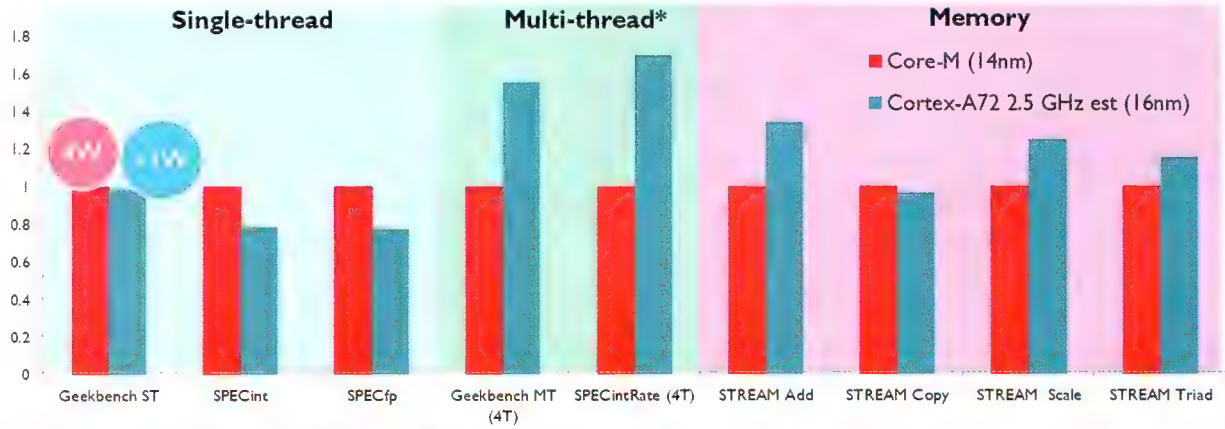
If you think the mobile SoC market is timid, lifeless and staid, follow the brouhaha surrounding the Snapdragon 810 and you'll see it's anything but. The whole thing boils down to a question of whether the 810 overheats.

Early reports of the LG G Flex 2 and HTC One M9 overheating helped to start the rot, and Samsung's decision to use its own Exynos 7 octa-core for the Galaxy S6 rather than the 810 fuelled more rumours. There are plenty of forum posts boasting stories of 810-equipped phones heating up and poor battery life as a result, but there are also those who think the whole story is total rubbish.

LG's G Flex 2 has been embroiled in Snapdragon 810 SoC overheating concerns

Chipmaker Qualcomm came out in late April this year, saying there's nothing wrong with the 810 and LG also piped up, claiming the G Flex 2 has no overheating problems (**tinyurl.com/pfpq7n8** and **tinyurl.com/ow8fjla**). By June, however, Sony reportedly admitted overheating issues with the Xperia Z3+/Z4, with a software fix on the way (**tinyurl.com/o84p3eg**).

Cortex-A72: More Performance Within Constrained Envelopes



- Intel workloads measured on Dell Venue Pro 11. SPEC benchmarks measured using gcc compiler v4.9 with –o3 flag.
- Cortex-A72 measured on RTL with realistic memory system with gcc compiler v4.9 - o3 settings.
- Multi-threaded workloads use 2C4T Core-M CPU and estimated on 4C Cortex-A72 configuration w/2MB L2 cache.
- Core-M 5Y10C has maximum rated frequency rating of 2GHz. (Source: ark.intel.com)
- For mult-threaded workloads, the Core-M will be thermally limited and not able to reach maximum target frequency.

The A72 is expected to give Intel's Broadwell Core M a run for its money.

Right or wrong, the effect has been to tarnish the Snapdragon 810 in the eyes of some, with the issue raised as a possible reason for sluggish HTC One M9 sales (**tinyurl.com/kp6xglm**).

MACHINE LEARNING NEURAL NETWORKS

Not surprisingly, Qualcomm is already moving on, with news it's producing a follow-up Snapdragon 820 for release as early as October this year. However, this won't be any ordinary chip – it'll feature a new customised 64-bit core called Kryo and will come with Qualcomm's brand-new Zeroth machine learning/cognitive computing platform (**tinyurl.com/n9q3n3a**).

In simple terms, the 820 will be able to learn how you use the device it's powering. This is tech you'd normally see kept in the cloud, but having this capability offline should lead to a raft of new applications and functionality, including improved security.

Deep learning is a stream of artificial intelligence (AI) being heavily researched at the moment and has applications well beyond smartphones – Qualcomm already envisages Zeroth making a splash in the automotive market (think lane detection and 3D navigation in smart cars, for starters).

NEXT-GENERATION ARM A72

Meanwhile, ARM is putting the final touches onto its next-generation high-performance core called the Cortex-A72 (**tinyurl.com/oycebyn**). It replaces the A57 atop the performance tree and will join the A53 in big.LITTLE devices. In terms of performance, this

The Galaxy S6 features Samsung's Exynos 7 octo-core SoC, using Cortex-A57 tech.

one will really motor – ARM rates the A72 as 1.8 times faster than the A57 and 3.5 times faster than the A15. Another way of looking at it, the A72 clocked at 1.1GHz will deliver the same performance as a 1.6GHz A15 core while using just one-quarter of the power consumption.

However, there'll be two versions and you'll need to wait until 2016 to get those headline performance ratings. Why? The A72's extraordinary figures are based on a tiny 16nm production process, which reportedly won't be available until next year. This year's crop of A72 SoCs will mostly be manufactured at 28nm scale, reducing the clock speed from 2.5GHz to 2GHz and doubling the power consumption of next year's 16nm versions.

That said, the 28nm A72 core will still only use half the power of an A15 and roughly 30% less than the A57. However, by the time the 16nm part arrives, the A72 should be at least six times faster than the Cortex-A9, which is an extraordinary gain in the eight years since the A9 was announced.

Qualcomm has flagged its upcoming 'mid-range' Snapdragon 618 and 620 SoCs will be based on the A72 at the 28nm scale, while MediaTek will launch a smaller-scale 20nm A72-based SoC in December 2015 called the Helio X20 (**heliox20.com**). It'll feature dual A72 and eight A53 cores, making it the world's first 10-core SoC, with those A72 cores clocking to 2.5GHz.

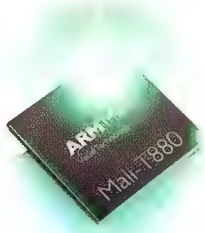
CATCHING INTEL BROADWELL

But among the more extraordinary claims of the A72 is that it should give Intel's new Broadwell-codenamed Core M a decent flogging. In unbridled single-threaded testing, Core M is still out in front by up to 25% on ARM's testing, but constrain the thermal availability and dial up the multi-threaded apps, and the A72 is claimed to leave the Core M in its wake, delivering close to 70% more performance (**tinyurl.com/m72rylu**).

Is it realistic? There's no doubt ARM has been steadily gaining ground on Intel's low-power parts, but we'll wait

Mali-T880: New Horizon for Mobile Visuals

The new Mali-T880 can scale up to 16 cores and mates with the Cortex-A72.



1.8x performance of 2014 Mali-T760 based devices

- Delivering advanced gaming and console-like experiences

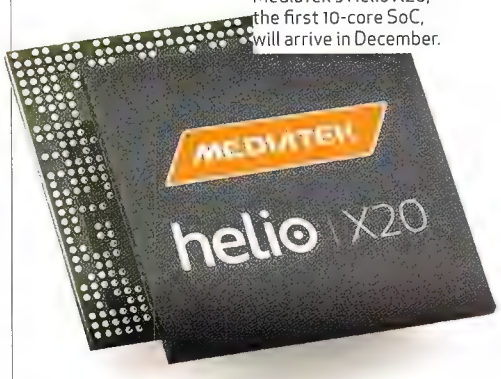
Most energy-efficient Mali GPU

- 40% energy reduction for same workloads

Enabling superior system level benefits

- Complemented by Mali-V550 video and Mali-DP550 display processors
- TrustZone® secure video path for premium 4K content

MediaTek's Helio X20, the first 10-core SoC, will arrive in December.



HTC's One M9 has struggled in sales, possibly due to the 810 heat claims.

for production device testing before considering this a done deal.

PICKING A GPU

Still, the Cortex-A series is only half the story. With Intel or AMD chips, you know the integrated GPU is going to be an in-house job – HD Graphics 4000, 5000 or 6000 series for Intel and Radeon something for AMD. But with ARM, you've not only got a smorgasbord of in-house Mali-branded options, you can also choose from third-party offerings such as the Imagination Technologies PowerVR series or Vivante GC range. Or if you're Qualcomm or Nvidia, you choose your own Adreno or GeForce tech, respectively.

Like the Cortex-A series itself, all Mali GPU designs are still available for licensing, so you could conceivably see any of these in your travels. Here's how they stack up.

> "The upcoming 16nm Cortex-A72, on paper at least, looks to be one of the more significant ARM releases since the A9."

- Mali-400MP. Part of ARM's initial Utgard GPU series, the Mali-400 scales to quad-core, but you want the 28nm build, not the 40nm – in 28nm sizing, a single core can punch through 55 Mtriangles per second (Mtri/s), but only 23Mtri/s in the 40nm guise. Four of these are inside the Exynos 4412 (Galaxy S III).
- Mali-450MP. This is scalable up to eight-core, pushing 142Mtris/s in quad-core at 28nm. MediaTek used four of these in the MT8127.
- Mali-T604. The first of its Midgard GPUs, the T604 is said to deliver up to five times the performance of a 400MP core, the Exynos 5250 Dual SoC having two T604 cores.
- Mali-T622/624/628/678. ARM churned out a second series of this generation in quick succession – the T622 has dual-core scalability, while the T624 has four-core and is said to pump out 50% more speed than the T604. The T628 scales up to eight cores, and the T678, also with eight-core scalability, claims to have four times the performance of the T624.
- Mali-T720. The entry-level third-gen GPU, the T720 can do 650Mtri/s in eight-core mode, but only needs 40% of the power of the T620 series.
- Mali-T760. The fastest third-gen ARM GPU, the T760, uses only a quarter of the power of the T604 and scales up to 16 cores. At that rate, ARM says it'll burn through 1,300Mtri/s in throughput.
- Mali-T820. The first of ARM's fourth-gen GPUs, the T820 tops the T622 by up to 40% and delivers 400Mtri/s throughput in its top four-core scalar design.
- Mali-T830. The T830 has an extra arithmetic pipeline, giving it a 55% performance premium over the Mali-T622, thanks to its quad-core scalability.
- Mali-T860. This upper-mid-range GPU scales to 16 cores, but uses just a little over half the power of the T628. It equals the T760 with 1,300Mtris/s throughput in 16-core configuration.
- Mali-T880. The T880 will be the top of the tree for performance when it arrives in late 2015/early 2016. It's said to be 80% faster than the T760 and hits 1,700Mtris/s throughput (16-core, 16nm) while using only 60% of the power. It's also designed to pair with the Cortex-A72 (**tinyurl.com/paxjzk5**).

WAIT FOR 2016

All up, if you're in the market for a new Android phone, we'd recommend holding onto whatever you have right now until next year, or buying only a mid-range unit to tide you over. The upcoming 16nm Cortex-A72, on paper at least, looks to be one of the more significant ARM releases since the A9 – any CPU that serves up 3.5 times the performance and one-quarter the power consumption of an A15 should be well worth the wait. Combined with the Mali-T880, which itself nearly doubles the performance at just over half the power consumption of its predecessor, they're performance and power figures you'd only dream about in a single notebook iteration.

However, that said, the machine learning tech that's appearing inside Qualcomm's Snapdragon 820 SoC could even leave the A72 behind. It's all going to make for a fascinating 2016 – and that's reason enough to keep our wallets closed until then.

Arduino Basics: hooking up DC motors

Nothing spells Arduino more than self-propelled projects. Darren Yates shows you how to connect DC motors to an Arduino Uno microcontroller.

Chances are the first time you hear about Arduino is when it's built into something that moves – anything from a robot to an automated lawnmover (tinyurl.com/qf5hkzs). It's also very likely the tech doing the 'moving' is one or more DC motors. However, the power demands of most DC motors not only require strong, high-capacity batteries, but often become too much for an Arduino board to handle.

ARDUINO NEEDS HELP

Think about moving several tonnes of rock – you're not going to do that yourself; you'll rope in an excavator or something. The same thing goes for Arduino and controlling DC motors – unless the motor is tiny, the Arduino Uno board can't power it on its own. Arduino has the brain, but not the muscle; however, the most common muscle for powering DC motors is what's known as a full-bridge driver or H-bridge for short.

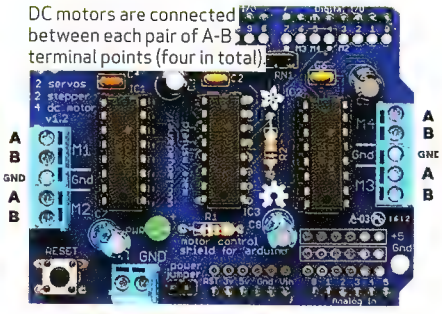
WHAT'S AN H-BRIDGE?

An H-bridge is an electrical circuit technique that uses four electronic switches or transistors to control a DC motor, where the motor is the horizontal bridge between two pairs of transistors. You can see from the diagram (right) that by carefully selecting which diagonally opposite pair of transistor switches is switched on, you can change the motor's rotation direction. Switch those transistors on and off at different rates and you can control the motor's speed in that direction – a technique called pulse width modulation (PWM).

Of course, there's more to it than that, but for our purposes, that's enough of the theory.

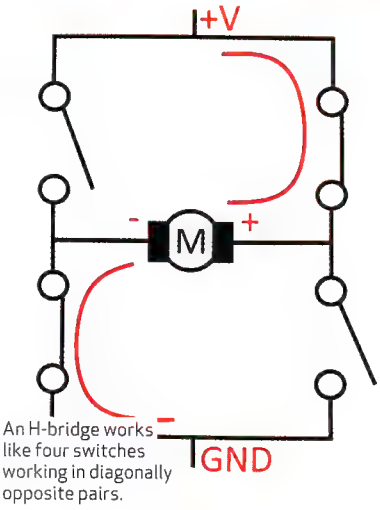
The plastic-geared GM2 motor is popular and cheap for light work.

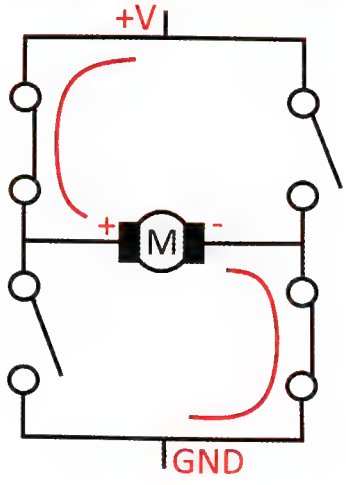
A 0.1uF capacitor across the motor contacts helps reduce electrical interference.



DC motors are connected between each pair of A-B terminal points (four in total).

How an H-bridge can change direction





An H-bridge works like four switches working in diagonally opposite pairs.

MOTOR DRIVE SHIELD

In a nutshell, that's also what happens inside the very popular Motor Drive Shield. This special Arduino add-on has two L293D dual H-bridge chips. Each chip can handle up to two DC motors and the two chips together can handle four. Add in support for two servo motors plus an ultrasonic sensor (both of which we've looked at previously), and it's easy to see why this shield is a popular choice for small robotics projects.

However, that's only half the story. DC motors come in all shapes and sizes and they have two main parameters: their working voltage and their current consumption. The L293D bridge can only handle small motors with a current draw of up to 600 milliamps (600mA) – anything larger than that and you need a more powerful solution (the L298D module is a start). So really, we're talking small hobby motors only, typically those rated around 6VDC at no more than 600mA, like the yellow GM2 motors used on robots.

CONNECTING POWER

The Motor Drive Shield has three terminal blocks: one small two-screw block and two five-terminal blocks. The smaller two-pin block provides the main power for the motors, shield and the Arduino Uno board itself if you choose. Next to that two-pin block, you'll find a small two-pin header bridge – keep this in place to have this main power feed also drive the

Metal-geared motors like this Pololu unit can better handle the rough stuff.

The shield can support DC motors, small servo motors and ultrasonic sensors.

Arduino. The two big terminal blocks provide connections for up to four motors (you typically ignore the middle GND pin in each block). Each outer pair of pins will be labelled M1 through M4.

WRITING THE CODE

To code the shield, the first thing is to load the AFMotor library into the libraries subfolder of your Arduino IDE installation, then reboot the IDE. Grab the latest version of the IDE (1.6.5) from **arduino.cc/download** and you'll find the library and demo source code on our website at **apcmag.com/magstuff**.

When writing your code, you must use the '#include' statement to add in the AFMotor library – that goes right at the top of your app. Next, you have to create an AF_DCMotor object, give it a name, define the H-bridge it uses (1 to 4) and set the clock rate of the digital signal sent to the motors. Remember the PWM we mentioned before? The code we apply here sets the clock rate. By using the 'MOTOR12_1KHZ' code, we're setting a 1kHz base clock rate.

MOVING THE MOTOR

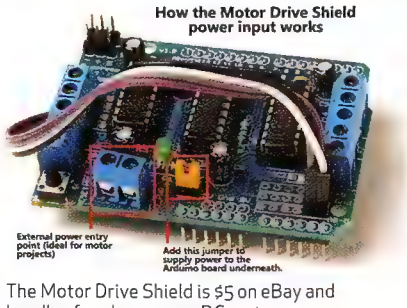
Once you've done that, there are only two commands you have to worry about from then on: 'motor.run' and 'motor.setSpeed'. Motor.run sets the direction and you provide it with a simple text command in brackets – FORWARD to go forward and BACKWARD to go in reverse. The 'Motor.setSpeed' command is a little more complex; here, you provide an 8-bit decimal number from 0 to 255, with 0 being stopped and 255 flat-stick.

MOTOR TORQUE

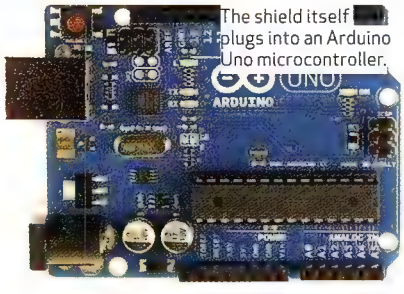
What that 8-bit number is doing is setting the proportion of time that power is applied to the motor in any one-millisecond interval (one cycle of a 1kHz waveform). The higher the number, the longer the power is applied, so setting it to 128 means the power is on for half of each cycle and off for half of each cycle. It's a relatively easy way to set the speed, but it's only one aspect of it.

Many hobby motor units, like the GM2, feature a built-in gearbox and a tiny high-speed motor. These motors can spin at incredible revs (10,000rpm or more), but in terms of the power they produce, they can barely blow out a candle. The gearbox reduces the revs, but gears up the torque, or the motor's pulling ability. You'll find 1:48 is a common ratio for these motors.

However, you only get the benefit of that torque if the motor is running flat-chat. Reduce the speed and you also reduce the torque, so a robot that will punch through walls at full speed will progressively struggle to find its way out of a wet paper bag as the speed is reduced. Ideally, if you need a lower rotational speed, you should look for a geared motor with a higher gear ratio (we've seen up to 1:224 with these smaller motors).


How the Motor Drive Shield power input works
External power entry point (ideal for motor projects)
Add this jumper to supply power to the Arduino board underneath.

The Motor Drive Shield is $5 on eBay and handles four low-power DC motors.



The shield itself plugs into an Arduino Uno microcontroller.

"The most common muscle for powering DC motors is what's known as a full-bridge driver or H-bridge."

If you're planning to use multiple motors, remember the power consumed adds up, so you'll need a decent set of AA batteries to power them. It's usually recommended you remove that little header bridge on the Motor Drive Shield and power the Arduino board separately using a 9V battery, as voltage fluctuations from a single supply powering the motors and the Arduino can lead to instability. That's the simple option, but it relies on two power sources.

You'll also need some basic soldering skills to attach wires to the motors that you can screw into the shield terminal blocks – if you don't know how, rope in a mate who does.

LEGO Mindstorms kits are popular, but building your own Arduino robots is way more fun.

JAYCAR IS YOUR ONE-STOP-SHOP FOR ARDUINO

If you have already immersed yourself into the exciting world of Arduino, or wanting to, then you'll love our extensive new range of Arduino compatible products we've affectionately named, **duinotech**. Here's just a small selection of the **duinotech** products on offer at Jaycar to build whatever creation you desire, from controlling lights or motors, to complete robotics applications. To learn more, download simple projects to get you started. Visit our dedicated website **deca.jaycar.net**.

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The most breadboard friendly device. Despite its size, it packs all the key features of a full duinotech board.

NEW

Microcontroller	ATmega328P
Clock	16MHz
Flash Memory	32kB
SRAM	2kB
Digital I/O Pins	14
Analog Pins	6
Serial Ports	1

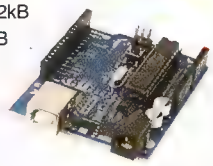
CLASSIC (UNO)

XC-4410 $29.95

Its stackable design makes adding expansion shields easy.

NEW

ATmega328P	
16MHz	
322kB	
2kB	
14	
6	
1	



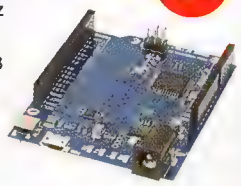
LITE (LEONARDO)

XC-4430 $29.95

Efficient & economical, duinotech Lite combines chipsets from the main controller & USB communication into one IC.

NEW

ATMega32u4	
16MHz	
322kB	
2.52kB	
7	
12	
2	



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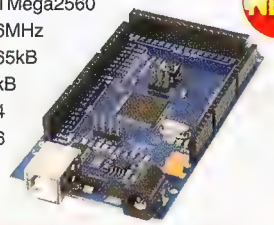

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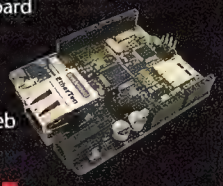

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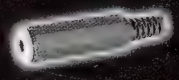

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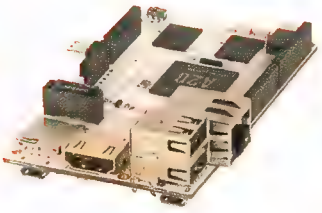

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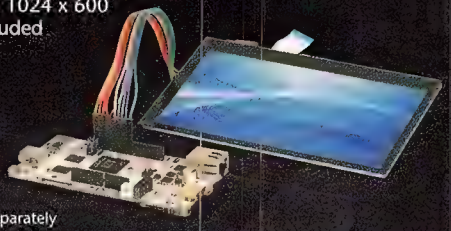

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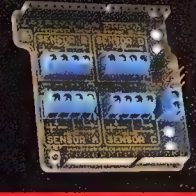

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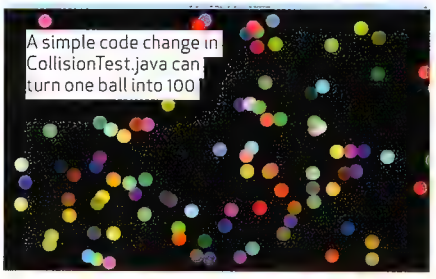
Part 12: Basic game development

This month, Darren Yates combines a number of our recent programming topics to step into basic games development and build a simple Java game called *JPong*.

Angry Birds is still one of the most widely recognised examples of games physics.

The CollisionTest.java project shows simple collision detection/resolution.



A simple code change in CollisionTest.java can turn one ball into 100

Over the last couple of months, we've taken a brief look at the concept of Object-Oriented Programming (OOP) and started playing around with Java graphics by coding Mandelbrot fractals. This month, we'll combine these two areas to take a look at some basic game development concepts on the way to making a simple Java game.

SIMPLE ANIMATION

When I was a kid, I loved drawing little cartoons in my school textbooks, each one just slightly different and then flicking the pages, seeing those drawings come to life. To be honest, I wasn't that good at it, but flipbook animations share many of the same basic principles with creating animations on a computer. Just like a flipbook cartoon, you want to move your digital object fractionally, but consistently, through each frame at regular intervals to give the illusion of movement.

WHAT'S A BALL?

To begin this month, I've written a small app called CollisionTest.java, which sends a ball bouncing around inside a Windows frame. Well, it's a bit more than that because with the addition of two characters (look at the code and you'll figure it out), you can change it from one ball to 100, each independently moving around the frame. The other thing is that it doesn't matter what type of computer you have, the frame rate is always the same – 50 frames per second (50fps).

There are a bucketload of ways you can code this, but on this occasion, we thought it was the perfect opportunity to pull in some recently covered OOP concepts, so we'll start by asking an odd question: what's a ball? Obviously, it's an object and it's round, but more specifically, in the context of 2D space, a moving ball has a number of attributes – starting with X-axis and Y-axis coordinates. It has a colour and, if it's moving, it has a rate of movement in those two axes. It can also have a function that determines its next position based on its current position and the rate of movement. All of that is enough for us to create a Java class called Ball, which we've added to the bottom of the CollisionTest.java code.

When we create an object from the Ball class, we're giving it a random start position somewhere in the JFrame, a random movement vector and a random colour. Open up the CollisionTest.java app and you'll see this in the CollisionTest() constructor and the balls.add() statement.

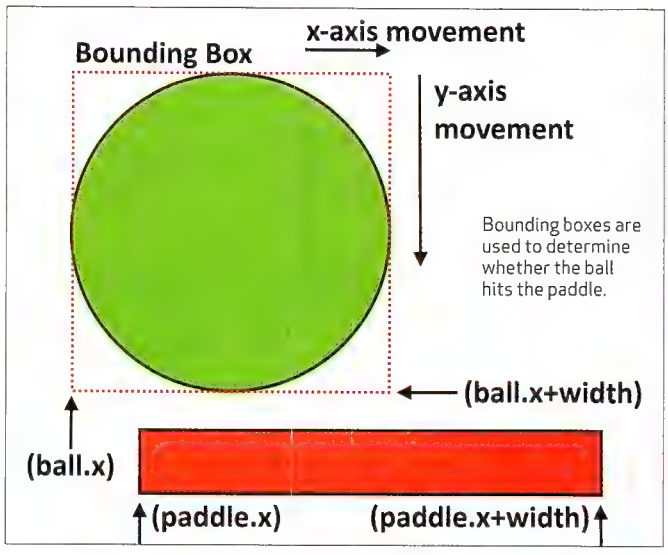
SETTING THE FRAME RATE

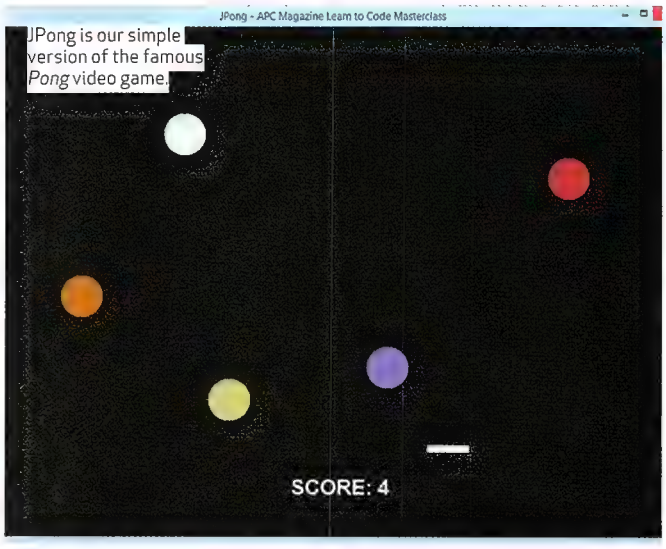
To get a smooth animation happening, you need to change the position of the ball at a fixed rate, and in Java, you can set that rate with the Timer class. First, we create a TimerListener object, whose job is to monitor a Timer and launch a function when that timer runs out. Next, we create the timer itself and for that, you create an instance of the Timer class, set the delay in milliseconds (ms) before it fires, the name of the TimerListener attached to run when the timer fires (here, called 'animate') and start it.

For silky-smooth animation, you need a frame rate faster than your eyes can resolve, which means at least 30fps. To a point, the faster the rate, the smoother the animation looks, but the faster the computer must operate. As a compromise, we've gone for 50fps, which means a timer delay of 20ms.

BAG OF BALLS

We can make one ball bounce around the app's JFrame, but with the addition of another coding feature we've looked at previously, it's easy to change the number of balls from one to a thousand. Right near the top of the code, we've added an ArrayList of type Ball, which allows us to create the coding equivalent of a bag of balls. Each ball





has its own parameters – position, movement, colour – and using Java's clever object-indexed for-loop, we can iterate through the ArrayList, update each ball and display the changes to the screen every 20ms.

Look at the TimerListener private class inside the Map class – inside the ActionPerformed() method, there's the object-indexed for-loop, which basically says, 'for each ball in the balls ArrayList, run the ball.move() method to update the ball position and when complete, repaint all of the balls on the screen'.

COLLISION DETECTION

That ball.move() method is the critical bit and allows us a simple introduction into a topic fundamental to action games through the ages: collision detection and resolution.

Looking at a single ball, the top-left corner is its origin point – if you're looking at the Ball class, it's the x and y integers (Ball.x and Ball.y). In our code, the height and width of the ball are both set to 60 pixels. However, the origin of that ball on the JPanel and the rate and direction of movement is set randomly when the Ball object is created and added to the balls ArrayList.

In our code, we start with a 1,024 x 768-pixel JFrame and on top of that, we create a JPanel object called 'map' and add it to the JFrame. The balls are drawn on the map JPanel. Like the balls, the top-left of that panel is the origin (0,0) and bottom-right, it's the furthest reach (1024,768).

The rate and direction of movement is set in the Ball class by two variables: dx and dy. Here, a positive dx number directs the ball moving right, while a negative value moves left. A positive dy number moves the ball down the screen; negative, up. Combine the two and you can move the ball in any direction around the panel. For example, if (dx, dy) is (-1,2), the ball will move at a rate of one pixel left and two pixels down.

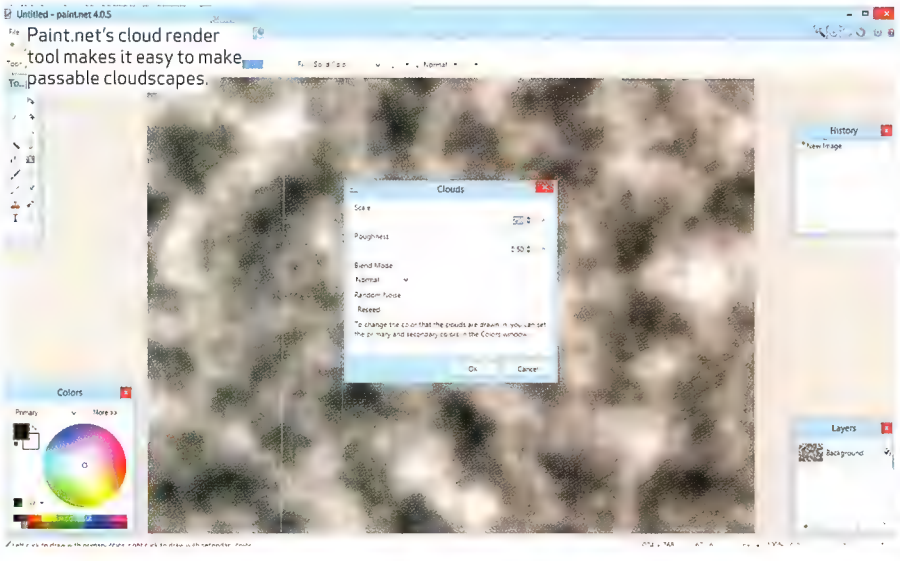
Now for the collision detection, which simply involves detecting when the ball hits one of the JPanel's four walls. We also need to resolve what happens once a wall is detected.

We're going to appropriate the Law of Reflection here, which says that the angle of incidence (the angle as the ball approaches the surface) equals the angle of reflection (the angle the ball moves away from the surface). This also assumes an elastic collision, where no energy is lost in the collision between the ball and the wall, leaving the ball to bounce around forever.

We're using these derivative dx and dy parameters because it's easier to deal with the vector movement as separate horizontal (x) and vertical (y) components. Say, for example, the ball is moving down-right and hits the bottom wall first. Using the Law of Reflection, the horizontal component doesn't change – the ball keeps moving right. What does change is the ball hits the wall and begins moving up. With no losses, the ball's upward rate of movement is the same as when it was moving down and it hit the wall.

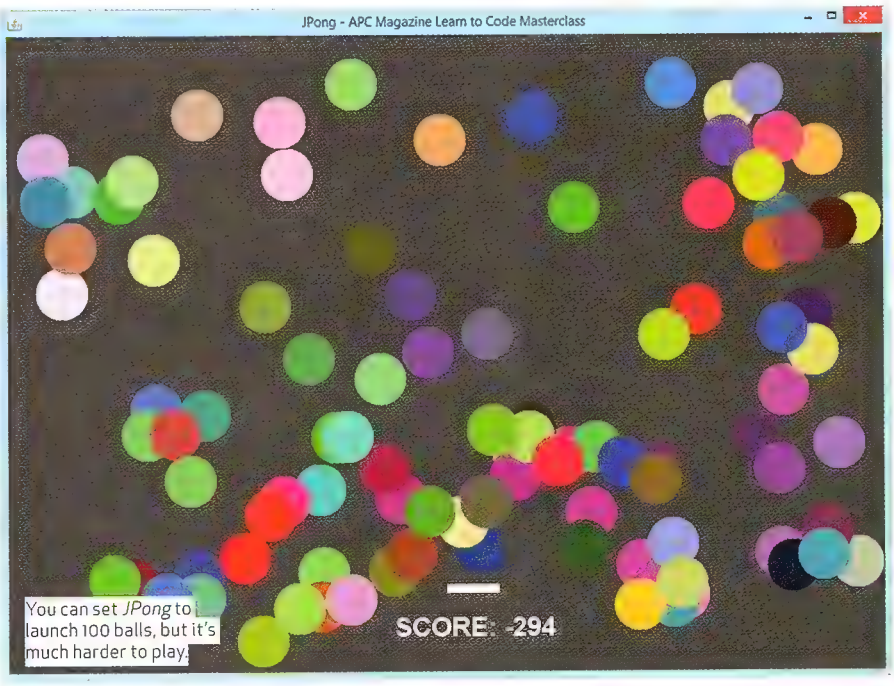
It might not be obvious, but we can do the reflection easily by simple negation. Look at the Ball.move() method – if the ball is within the panel, we add the current movement rate (dx) to the current horizontal position (x). But if the ball has hit either the left or right wall, we negate the horizontal movement component (dx = -dx) and add that to the current horizontal position. The negation turns a negative into a positive and a positive into a negative, so we can handle changes of direction in either direction here. We also do likewise in the vertical plane with the top and bottom walls, the dy and y positional values.

Do all of this every 20-ms and you get the effect of a ball (or many balls) bouncing around the frame.



BALLS TO SPITFIRES

Having balls bouncing around the screen is cute, but you can take things



Collision Test #1 - APC Magazine Learn to Code Masterclass
Change g.fillOval to g.drawOval to give line art rather than solid balls

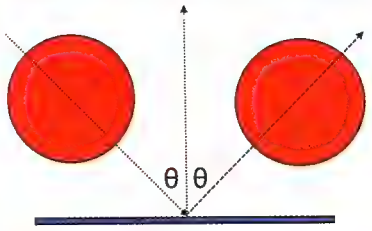
"We have enough tools in our arsenal to make a simple variation on the famous *Pong* video game."

further quite simply by changing the balls to Spitfire aeroplanes flying in the clouds. First, we generate the cloud using Paint.net (**www.getpaint.net**) and its cloud render function. We create a 1,024 x 768-pixel image using that render option ('Effects > Render > Cloud') and run it through the Sepia filter ('Adjustments > Sepia') to create our background.

Have a look at the CollisionTest2.java project. To draw that cloud image onto the Map panel, we create an Image object called jpgCloud, built from the embedded cloud.jpg file we made earlier. We've also created a stylised top-down view of a Spitfire fighter plane from another image, turned it into a .png image with a transparent background and brought that in as an Image object called 'spit'.

If you take a look at the Map class's paintComponent() method and compare it to that of CollisionTest.java, you'll see we've replaced the g.fillOval statement with a g.drawImage statement instead. The Ball class is still there, but now represents the position and movement of a Spitfire image object. Run that code and you'll see several Spitfire planes now bouncing around the panel on a sepia cloud. Two very different looks, but the source codes are substantially the same.

Collision movement resolution



Angle of incidence = Angle of reflection (horizontal component does not change, vertical component becomes its negative)

The Law of Reflection shows how a perfect collision between ball and wall works.

JPONG

We're still miles away from creating a *1942* arcade flying game, but we do have enough tools in our arsenal to make a simple variation on the famous *Pong* video game. Load up the *JPong*. java project and run it. Essentially, you have a paddle that moves right and left, but instead of having to beat an opponent, your job is to just stop five balls from hitting the bottom wall. For every ball you get back in the air, you score one point; for every ball you let past, you lose a point. The game is initially set to run five balls, but you can change the number of balls in the same way as the CollisionTest.java code. One warning, though – adding more balls just makes it harder.

The addition to this project is the Paddle class. Again, the paddle is just another object with parameters and movement, ripe for modelling as a class. To move the paddle, you use the keyboard right and left arrow keys and to monitor these keys, we add in a KeyListener object. It monitors the keyboard, so that when a key is pressed, we know which key it is, and based on that, we either add or subtract the dx rate of movement parameter to the paddle's x position (paddle.x) and update the position on the screen.

The collision detection here is determined by whether each ball comes in contact with the paddle on the ball's downward movement (we check for this to ensure we don't incorrectly detect balls having just bounced off the bottom wall). When a collision is detected, the score parameter stored as part of the Paddle

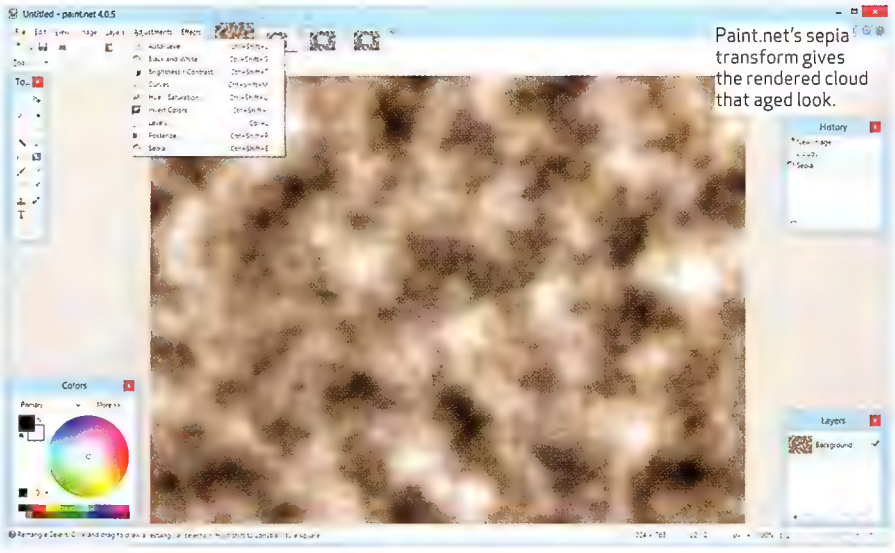
object is incremented if the ball bounces off the paddle and decremented if it's off the back wall. That score is then displayed on the screen using the g.drawString statement in the Map class. The basis of the detection is we start with the ball's current x and y position and compare that to the same of the paddle. If the ball position matches the paddle position, a collision is deemed to have occurred. It's simple and crude, but it works.

MORE MATHS AND PHYSICS

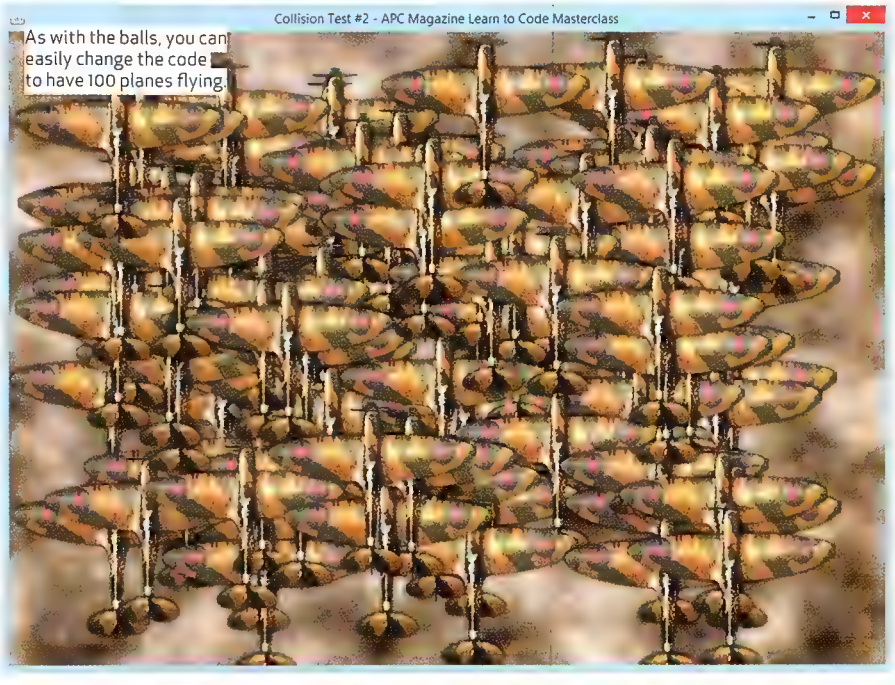
We're not about to insult serious game developers and suggest you can start coding blockbuster games by simply reading one article – at best, all we've done is scratch the lacquer covering the paint over the primer on top of the surface that is games development. Even with 2D gaming, there are plenty of other things to learn, from sprites to threads to frame buffering to multi-object impulse-momentum collision resolution.

Most of us have moved on from it, but *Angry Birds* is one of the most common examples of realistic physics collision resolution. If you still have it on your phone or tablet, play the first episode again, but this time, look at the interaction between the birds and the building components, and also how those components interact with each other. This interaction was created using a free physics engine called Box2D (**box2d.org**). Like many high-performance games, Box2D uses C++ to obtain maximum performance.

Thankfully, you don't have to go that far to start writing your own basic Java games – even with just the little we've done this month in the three projects, you've got enough kit to start playing around and writing simple games of your own.



Collision Test #2 - APC Magazine Learn to Code Masterclass
CollisionTest2.java is a modification that turns the balls into Spitfire planes


Collision Test #2 - APC Magazine Learn to Code Masterclass
As with the balls, you can easily change the code to have 100 planes flying

Getting the code

You'll find the source code pack for this month's three projects at our website (**www.apcmag.com/magstuff**). Unzip the file and you'll find three further .zip files inside – one for each project. You'll also need the Java 8 Software Development Kit (SDK) and the latest NetBeans IDE (Integrated Development Environment) from **netbeans.org**. Install Java first and then the IDE. Launch the IDE, select 'File > Import Project > From Zip', select one of the three .zip files, load it up and run it. Make sure you muck around with it, too – change the code and see what happens. It comes with no warranty whatsoever.

apc RECOMMENDS

Seeds are puny individually, but strong in packs – watch out for Cradles, who can spawn more of the buggers.

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Massive Chalice

Double Fine's cup runneth over.

Don't think about it too much. That may seem like strange advice for an entry in one of gaming's more lobe-taxing genres, the small squad turn-based strategy, where a single bad move could spell permadeath for one of your precious few troops. But it absolutely holds for Double Fine's bright-on-the-surface, dark-on-the-underbelly game of playing family tree surgeon while slaying monsters simultaneously.

By all means, you should plan your heroes' moves. But when you're confining an over-indulging, near-sighted bowman to a life of forced celibacy because he's about as reliably lethal as a potato in a tailpipe, don't think about it too much.

Subversive though it is, playing matchmaker and eugenicist sees *Massive Chalice* at both its best and its worst. The reason you're getting involved in the conceptually icky business of sex management at all is that there are wolves at the door, and only heroic bloodlines can stave them off. By 'wolves', we mean a monstrous, world-devouring entity called the Cadence. And by 'door', we mean your island kingdom, segmented up into regions and beset on all sides by the clementine ooze that represents the creeping forces of evil. There's no winning this fight by mortal means, but if you can buy the eponymous giant magical goblet enough time – 300 years to be precise – then it can trigger a devastating shockwave that will end the threat for good. Yes, you read that right: 300 years.

As the kingdom's immortal ruler, only you have the strategic oversight and longevity to see this through to the end. And so romance be damned: you need an enduring supply of not-awful heroes, which means you'll need to become a selective breeder, ensuring that bad traits don't get passed down to sour your defence a hundred years later. Early on, when heroes are a scarce resource, the choices are overwhelming, but captivating. Appointing a Keep's first regent and their partner does much to set the family's path because whoever sits on the throne defines the primary class of their offspring, modified by their partner to deliver an array of punnily named hybrids.

The combat is varied, too, although not quite as accomplished, lacking the transparent teeth and foreboding atmosphere that define its obvious influence: Firaxis' *XCOM* reboot. Part of the problem is detachment; since every hero is destined to pass into Death's skeletal hands by causes violent or natural, it feels foolish to invest in the same way you do in a badass supersoldier in Archangel armour.

The beautiful maps and a smattering of environmental hazards enliven fieldwork too, and the generally competent AI will usually punish mistakes and seek hiding spots in the fog of war, even if its pathfinding is occasionally as questionable as a hero fighting under the influence of the bottle.

It doesn't come close to dethroning the granddaddy of the genre. And no, it's not 11-odd flawless hours of challenging tactical combat. But it is an epic strategy game in a different sense to the norm, and a welcoming, colourful one. Just don't think about it too much.

■ Matt Clapham

Verdict

Grand and inventive, the turn-based strategy genre looks (double) fine wearing its new genes.

★★★★☆

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Fallout Shelter

The world's ended, and everyone's at vault.

The human brain is a fascinating thing, isn't it? It loves to tap. To build. To gain virtual XP while prodding slack-jawed at a mobile screen. The exceptionally attractive *Fallout Shelter* is what happens when Bethesda gets in on the action, and this free-to-play surprise takes all of these impulses to a dangerous new level. Welcome to the post-nuclear strategy-simulation you never knew you needed.

The setup is instantly compelling. You're the proud Overseer of an all-new bunker, with a group of grinning, Vault Boy-style dwellers depending on you for survival. Although that can all wait until after the excitement of choosing your very own vault number. That done, it's time to start building and staffing rooms to provide food, water and power. Keep production above the required level with a series of finger prods and Bob's your non-radiation poisoned uncle. Sound simple? As is the beauty of so many free-to-play games, it is. But as with so many things *Fallout*, it's also so much more.

BOTTLE TAPS

In the world of *Shelter*, just like its wasteland-exploring big brother, stats are king, and every dweller has their very own SPECIAL ratings. Dwellers do better in rooms that match their abilities, so studying them is essential. High perception? Into water production you go. Good endurance? You can head out into the wide world to scavenge, and we'll read about your amusing adventures from the safety of the vault. Add this to balancing just the right number of rooms and things get interesting, as more facilities and upgrade opportunities unlock. Build down too fast and you'll quickly find yourself in unhappy-ville, without enough of anything to go around, and nasty red radiation appearing in health bars.

Navigating rooms is a joy, and dwellers are easily dragged around. Breeding is morally ambiguous but darkly amusing. Get a charismatic couple in the living quarters together, and after a small sample of the great writing on offer ("Are we in a Vertibird? Because my heart is taking off!"), the pair will disappear together. It's little details, like the man skipping out and the woman slowly shuffling, heavily pregnant, that set the tone here. Each room is pleasingly rich with sound effects to match, and you'll find yourself exploring between taps. Plus, if you thought it was just radiation you had to worry about, fire, Radroach invasions, and Raiders arriving from the wasteland are regular occurrences. Here's where the micro-transactions become tempting.

While weapons to tackle enemies and outfits to improve stats can be earned as you send dwellers out into the wasteland, they're also to be found in randomised lunch boxes. These can be bought with real cash, but it's up to you whether you earn these via objective completion or fork out. It's a refreshing change that you never need to pay to rush rooms, but if you want loot, the offer's there.

Fallout Shelter is both free-to-play's solution and problem. While it shows that the genre doesn't necessarily need to constantly have one hand in your wallet, the nuclear apocalypse may well be imminent and we'll be too busy tapping to notice.

■ Louise Blain

Verdict

Addictive mobile gaming done right – Bethesda has given us enough to survive until November.

★★★★½

apc RECOMMENDS

Spare car/soccer puns: Koenigsegg Aguero, Steve McLaren and Robin Van Persie.

"Games will always resemble pinball more than a soccer match.

FROM US$19.99 | PC, PS4 | ROCKETLEAGUE.PSYONIX.COM

Rocket League

All together now: the ref is a tanker!

Remember the day in the school holidays when you and your mates invented the Best Game Ever? That variant of tag played with a rugby ball, where the floor was lava and you had to get to the paddling pool? We'll never get bored of this, you all vowed, making concrete plans to spend the next five-and-a-half weeks playing it morning through night. This is what we live for now.

Psyonix's car/soccer crossbreed summons many of the same feelings. Your debut in one of *Rocket League*'s surprisingly comely arenas is a revelation of simple pleasure. It's a motorised game of playground soccer, the ball perpetually ensconced in a mob of jostling pursuers as it's nudged to and fro on a *Speedball*-esque pitch.

Matches are 3v3 by default, but the adventurous can search for anything from 2v2 to 4v4 encounters, or go 'mano-a-mono' with a single opponent. All configurations create absolute chaos, but generally the fewer cars on the pitch, the more free-flowing the game. 'Rush keeper' arrangements are hastily agreed when the ball lollops its way into your team's half, otherwise you're all playing free roles.

One second you're Marco Maserati, barging folks and seeing off danger from your own goalmouth; five seconds later you've used a speed boost to zoom up to the opposite end and have become Edinson Pagani, launching yourself at Andrés Fiesta's crosses for a crack at a goal.

SPYKER STRIKERS

For a long time, you'll flap and flail like Nicklas Mercedes-Bendtner. You'll misjudge jumps, use your boost at the wrong time, score own goals and nudge goal-bound shots from teammates harmlessly wide. It's frustrating to a degree, but then you look around and remember you're playing soccer with a van.

It's not meant to be FIFA and while you'll find something approaching finesse after hours of play, games will always resemble pinball more than a Premier League clash, but they're consistently thrilling for the sheer number of ridiculous misses and high-scoring encounters generated.

After a non-start on launch day when its servers fell over immediately upon its induction into July's Instant Game Collection for PlayStation Plus subscribers, online play's remained fairly stable since. Matchmaking can take a while, but it's worth it once you're in. At the time of writing, it's one of the most fun things you can do with a PS4 for free.

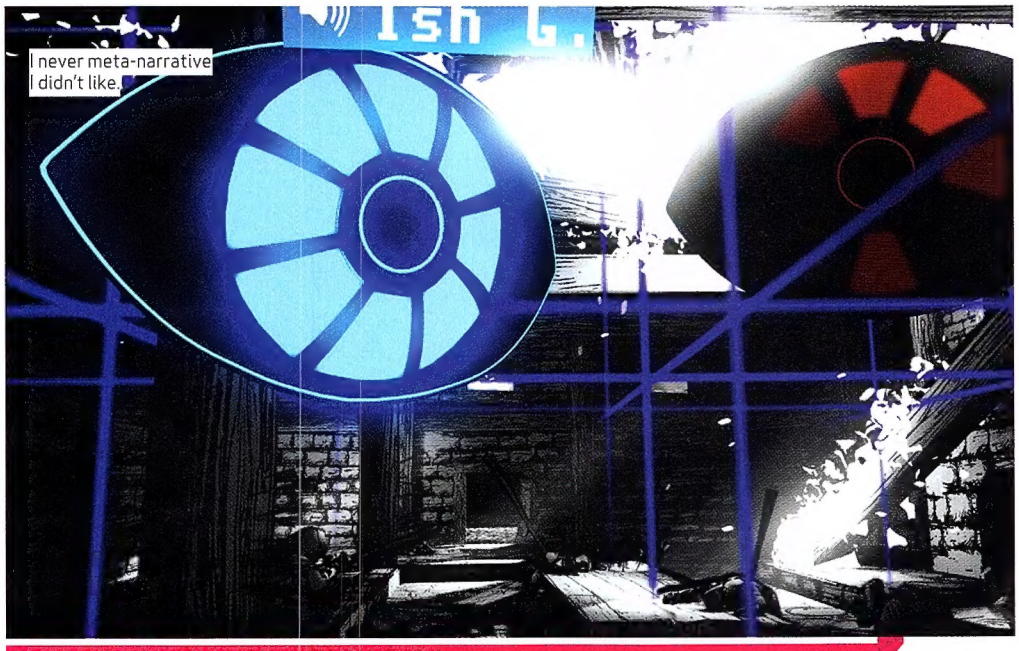
But like the Best Game Ever you and your comrades never did go back to like you'd promised, the bubble does burst. After days of solid play with no long game to keep in mind, my interest's starting to wane. And when *Rocket League* departs from Plus, there's a danger its online community will, too. Until then, embrace your inner Car-im Benzemas and enjoy it while it lasts.

Phil Iwaniuk

Verdict

The perfect offering – intoxicating fun for a few weeks, dependent on a large online community.

★★★★☆



US$19.99 | PC | WWW.MAGICCIRCLEGAME.COM

The Magic Circle

A self-aware game within a game.

There have been plenty of films set inside the movie industry, such as *The Player* or *Barton Fink*. There have been plenty of songs about the music industry, like Belle & Sebastian's 'Seymour Stein' or The Sex Pistols' 'EMI'. But games is a field that's mostly escaped the satirical art of navel-gazing, save for isolated incidents such as *Game Dev Tycoon*. *The Magic Circle* aims to change that.

In the game, you play a tester, wandering through an unfinished game that's been delayed since time immemorial due to the ego of its legendary lead designer Starfather, a diva who hasn't released a title since text adventures were the peak of tech. But a public demo needs to be ready for the big E4 conference to satisfy his fans and release something, anything.

Bearing in mind that back-story, much of the game is placeholder, from the landscapes and commentaries to the art style and the setting. Your task, set by Pro (a disgruntled protagonist left over from an abandoned science-fiction prototype), is to finish the game. But Starfather is determined to make it as dreadful as possible and delay the release, while his fangirl intern Coda and blackmailed pro gamer Maze both have their own agendas. All three appear in the world, as they debug and change it around you.

You play the game from a first-person perspective. Early on, you're given the power to trap enemies and edit them – that is, go into their code and alter their default behaviours – whether they fly or run, attack with melee or a railgun, regard you as a friend or foe. Even whether they're fireproof or share a group mind, or can teleport others or open force fields, or... you get the idea.

It's a great mechanic and turns the game into a kind of action strategy as you wander the small world, using your growing pack of bizarrely edited monsters to defeat other creatures and acquire their abilities, and bypass puzzles. The world itself has a variety of attractive art styles, from monochrome sword-and-sorcery to the abandoned science-fiction version to a dungeon editor. There's a section where you redesign the game, and watch an AI play it for you. It's all tongue-in-cheek and hugely self-referential, if a little trite.

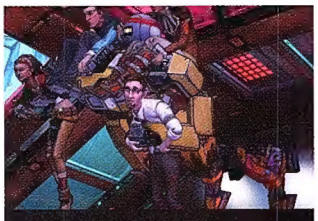
Despite that, the game feels like it was intended to be more ambitious than it is, as if it suffered cuts itself. The explorable world is small, the number of actual puzzles limited. A comprehensive run-through took us just seven hours, and there was little we felt the need to return for. Despite that, the well-written satire, the customisability of the world, and the knowingness of the game make it an enjoyable ride.

Games don't do humour well. Perhaps only the LucasArts adventures and *Time Gentlemen, Please!* have been laugh-out loud funny in recent years. *The Magic Circle* is smarter than it is witty, but it's a knowing, acerbic and fun look at big egos and failures in big game development.

■ Daniel Griliopoulos

Verdict

There's a unique enemy-editing mechanic and attractive art style, but it has a rather small game world.



Tales from the Borderlands Episode 3 – Catch a Ride

The blast of us.

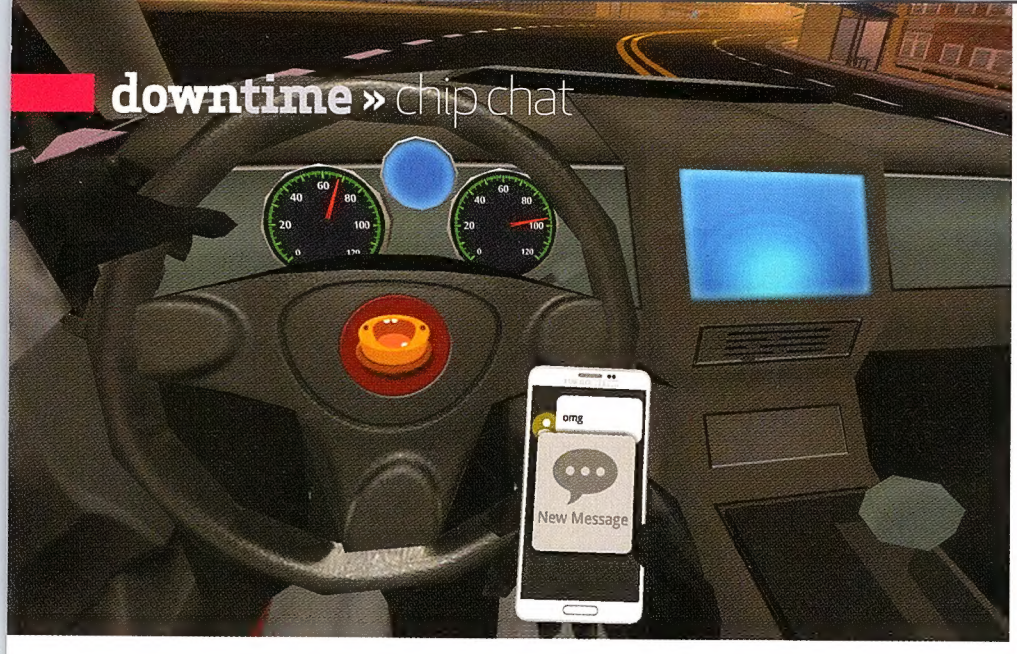
FROM $6.65 | XBI, PS4, PC
WWW.TELLTALEGAMES.COM

Sending you down one of two distinct and divergent paths depending on your decision at the end of episode two, this is Telltale's most ambitious serving of episodic adventure yet.

Lay down your rocks of justice for a moment though, and I'll do my best. This being the mid-point in the series, it'd be easy for Episode 3 to fall victim to dithering while Telltale's writers set up the really meaty stuff for the finale. In reality, it's the opposite as Rhys and Fiona feel closer to finding the vault than ever. You'll feel a sense of almost over-familiarity with the broader strokes such as the surprise entry of a new foe and the obligatory 'searching for something in a big room until an unexpected thing happens' chapter. However, as always, *Tales from the Borderlands*' top-notch writing saves the day.

The Last of Us fanboys and girls will need to take their calm pills before witnessing the reunion of Troy Baker and Ashley Johnson as Rhys and ultra-endearing robot Gortys, respectively. Johnson instantly falls in line with the incredibly high standard of comedic delivery upheld from the start of Episode 1.

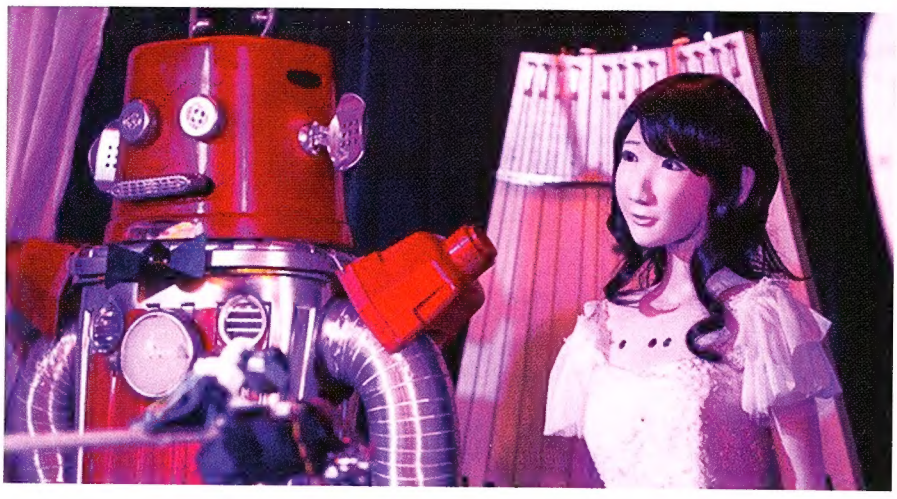
This, along with Telltale's wonderful scripting, will bond you to the *Borderlands* brand even if Randy Pitchford personally breaks into your house just to leave the fridge door open so all your food goes off. How Episode 3's branches will meet again without negating the weight of your decisions remains to be seen, but it's been a hell of a ride so far. ■ Phil Iwaniuk



SMS Racing brings texting and driving together at last

Prepare for the ultimate racing challenge…

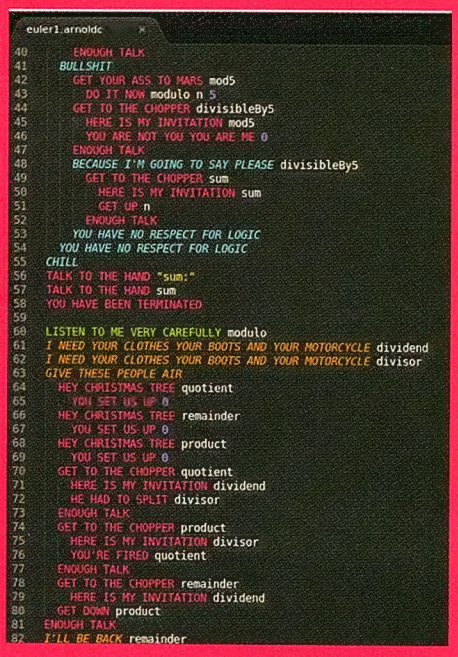
If you thought other racers, windy tracks and countdown clocks would always be the biggest challenges a racing game could pit you against, think again — *SMS Racing*, a new game from developer Turbo Button, ramps up the difficulty by tasking you with the toughest trial yet — texting while driving. Hilariously highlighting the absurdity of performing the act in real life, the Samsung Gear VR game gives you 10 seconds to look down at your phone and text your friends back, or else risk losing their friendship forever. A pre-alpha demo is available now, with the full game expected to arrive late 2015.



MARRIAGE EQUALITY COMES TO JAPAN… FOR ROBOTS

DOMO ARIGATO, MR. ROBOTO.

Marriage equality is a hot-button issue in Australia at the moment, but in Japan, a marriage has taken place that likely involved literal hot buttons — two Japanese robots officially tied the knot in late June, with a lavish ceremony attended by over 100 guests. Officiated by another robot named Pepper, groom Frois and bride Roborin even managed to seal the deal with a big ol' robo-kiss, eventually concluding the evening with the traditional cutting of the cake. The wedding was organised by the art collective Maywa Denki, which consists of two brothers who are responsible for creating various electronic machines, including the aforementioned groom.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I NEED YOUR CLOTHES YOUR BOOTS AND YOUR MOTORCYCLE divisor
GIVE THESE PEOPLE AIR
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GET TO THE CHOPPER quotient
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ENOUGH TALK
GET TO THE CHOPPER remainder
HERE IS MY INVITATION dividend
GET DOWN product
ENOUGH TALK
I'LL BE BACK remainder

Meet ArnoldC: the Schwarzenegger-inspired programming language

NO RESPECT FOR LOGIC? LACK DISCIPLINE? HASTA LA VISTA, BABY.

Hey you! Put that cookie down and listen. Do you think that coding is boring? Need to let off some steam? A new programming language based on Arnold Schwarzenegger's most famous one-liners may just liven up your coding efforts. Dubbed ArnoldC, the coding language replaces the usual dry commands with some choice Arnie zingers. Why? Because 'GET YOUR ASS TO MARS' sounds a whole lot better than 'AssignVariableFromMethodCall'. If this kind of thing sounds right up your alley, you can download it for yourself from GitHub (**lhartikk.github.io/ArnoldC**). Just be careful — Arnold doesn't do requests.

Russian government warns citizens about the danger of selfies

IN COMMUNIST RUSSIA, SELFIE TAKES YOU!

It turns out that taking selfies isn't just a narcissistic activity to partake in — it's also a deadly one. High-risk selfie poses have so far caused hundreds of injuries and dozens of deaths in Russia, forcing the government to create an informational pamphlet that aims to educate people on how to avoid death while taking photos of themselves. "A cool selfie could cost you your life," warns the pamphlet, which comes after several selfie-related deaths, including two young men who died while photographing themselves holding a grenade with the pin pulled out. ■

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